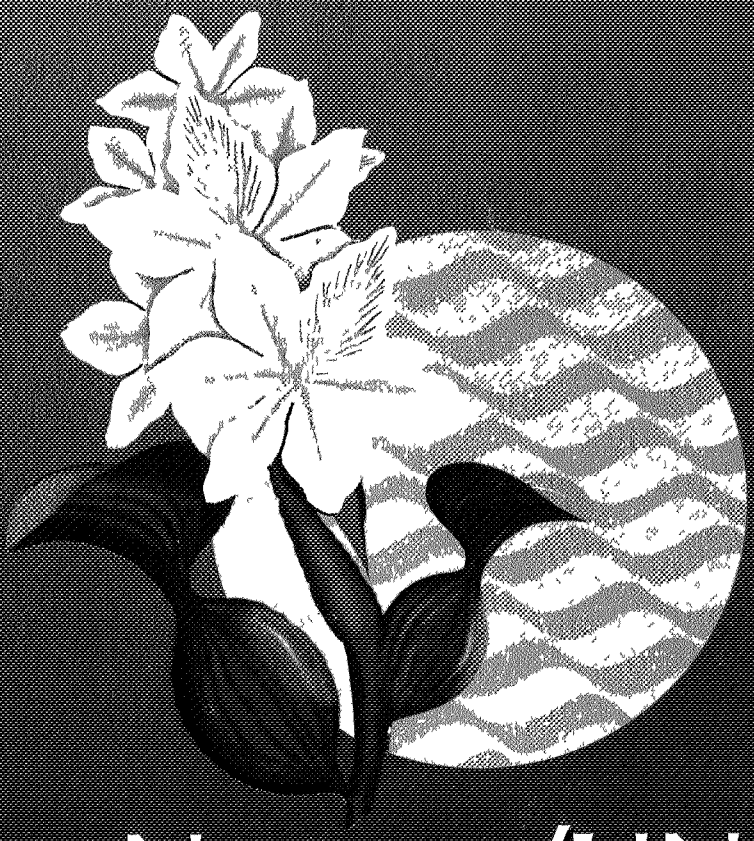
Chairman´s Report

Conclusions and recommendations from presentations and discussion



Norway/UN Conference on Alien Species

The Trondheim Conferences on Biodiversity

1 - 5 July 1996

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Hosted by

- The Royal Norwegian Ministry of the Environment

In collaboration with

- United Nations Educational, Scientific and Cultural Organisation (UNESCO)
- United Nations Environment Programme (UNEP)
- The Royal Norwegian Ministry of Agriculture
- The Royal Norwegian Ministry of Fisheries
- The Royal Norwegian Ministry of Foreign Affairs

Organised by

- Norwegian Directorate for Nature Management (DN)
- Norwegian Institute for Nature Research (NINA)
- Centre for Environment and Development (SMU), Norwegian University for Science and Technology (NTNU)

Held at Reso Royal Garden Hotel, Trondheim, Norway

Conference Chair
- Peter J. Schei

Conference Director
- Odd Terje Sandlund

Conference Secretary
- Åslaug Viken

Represented in the International Advisory Group
- United Nations Educational, Scientific and Cultural Organisation (UNESCO)
- United Nations Environment Programme (UNEP)
- United Nations Food and Agriculture Organisation (FAO)
- Secretariat of the Convention on Biological Diversity (CBD)
- Scientific Committee on Problems of the Environment (SCOPE) of the International Council of Scientific Unions (ICSU)
- World Conservation Union (IUCN)
- IUCN's Invasive Species Specialist Group (ISSG)

Represented in the Conference Committee
- The Royal Norwegian Ministry of Agriculture
- The Royal Norwegian Ministry of Fisheries
- The Royal Norwegian Ministry of Foreign Affairs
- The Royal Norwegian Ministry of the Environment
- Norwegian Directorate for Nature Management (DN)
- Norwegian Agency for Development Co-operation (NORAD)
- Norwegian Research Council
- Norwegian Institute for Nature Research (NINA)
- Centre for Environment and Development (SMU), Norwegian University for Science and Technology (NTNU)
- Norwegian Institute of Marine Research

Technical organisers
- Norwegian Institute for Nature Research (NINA)
- Foundation for Continuing Education of the Norwegian Institute of Technology (SEVU)

Conference Chairman and responsible for the report
- Peter J. Schei, DN

Conference rapporteurs and editors
- Finn Kterås, DN
- Bjørn Åge Tømmerås, NINA

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- Mick Clout, IUCN/ISSG
- Jorge Illueca, UNEP
- Pierre Lasserre, UNESCO
- John Matuszak, US Department of State, USA
- Jeffrey McNeely, IUCN
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- Jameson Seyani, National Herbarium and Botanical Gardens, Malawi

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- Frøydis Kvaløy, DN
- Norunn S. Myklebust, DN
- Gunn Paulsen, DN

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Directorate for Nature Management (DN)
and Norwegian Institute for Nature Research (NINA)
Tungasletta 2, N-7005 Trondheim, Norway

Tel.: +47 73 58 05 00, Fax: +47 73 91 54 33

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Conclusions and recommendations from the UN/Norway Conference on Alien Species, Trondheim, Norway, 1-5 July 1996

Article 8 (h) of the Convention on Biological Diversity calls on each Contracting Party to, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.

Scientists, managers and policy advisors from 80 countries and representatives from several UN bodies, institutions and organisations gathered in Trondheim on 1 - 5 July 1996, at the invitation of the Government of Norway, against the background of the challenges related to the implementation of relevant provisions in article 8 of the Convention on Biological Diversity related to alien species.

Introductions can be accidental or deliberate, and these may require different policy and management responses. The most important vectors for accidental introductions of invasive species are related to international transport, i.e. to trade and commerce and to travel and tourism, while the most important vectors for deliberate introductions are related to biological production systems, e.g. agriculture, forestry and fisheries. When deliberately introducing an alien species, there is a need to undertake pre-introduction screening and to strike the right balance between the benefits of using the species with the costs involved, including long-term impacts, and to take due concern for uncertainty.

Alien species are species that occur in places different from their area of natural distribution. Some alien species become invasive, meaning that they threaten ecosystems, habitats or species. Several factors affect the potential for alien species to establish and become invasive. Our growing physical and chemical influence on the ecosystems increase the likelihood of these aliens becoming invasives.

Invasive species were identified as a serious global threat to biological diversity, and in some countries the most important threat. Such species threaten the natural and productive systems which they invade, and have in many cases caused disruption of ecological systems, homogenisation of biota and extinctions. This has often resulted in significant environmental, economic, health and social problems, imposing costs in the billions of dollars and seriously affecting a large number of people.

The environmental problems resulting from invasive species need to be addressed at the genetic, species and ecosystem levels. Important areas for management follow-up include capacity building, quarantine measures, risk assessment and risk analysis and review and development of legal and economic instruments. More focus is needed on the economic costs of alien species, while at the same time taking into consideration conflicting interests and distribution effects.

All sectors involved in activities related to invasive species must have a role in implementing preventive and corrective action. This includes the transport sector, involving e.g. shipping, tourism and trade, and the primary production sector, e.g. agriculture, forestry and fisheries. Technical and practical co-operation, both nationally and internationally, is needed between environment, veterinary, phytosanitary and health authorities working with aliens, in such a way that prompt and appropriate action can be taken when needed.

Information and education strategies on invasive species are needed urgently at the national level.

International compilation of information on invasive species (comparable to that available for agricultural pests and infectious diseases), and the dissemination of this information, is a high priority.

Support of networks of specialists providing expertise relating to prevention and management of invasive species should be strengthened.

Developing countries need various sorts of assistance, not least to facilitate capacity building, that will enable them to strengthen their work related to alien species.

A scientifically based global strategy and action plan to deal with the problem of invasive species is urgently needed. Such strategies and plans should also be developed at the national and regional level.

The Trondheim conference urges national governments and international organisations and institutions to seriously address the issue of invasive species in their ongoing deliberations related to biological diversity.

The Trondheim conference on alien species offers its conclusions and recommendations to the Conference of the Parties to the Convention on Biological Diversity as a contribution to its work programme in implementing article 8. It is also offering its conclusions and recommendations to other relevant and appropriate international organisations and agreements working with issues related to alien species.

Introduction

The Norway/United Nations (UN) Conference on Alien Species was hosted by the Norwegian Ministry of the Environment on behalf of the Government of Norway. The organisation and sponsoring of the conference was a joint venture between the Norwegian Ministry of Environment, the Ministry of Agriculture, the Ministry of Fisheries and the Ministry of Foreign Affairs. The conference was organised in collaboration with the United Nations Environment Programme (UNEP) and the United Nations Educational, Scientific and Cultural Organisation (UNESCO). The United Nations Food and Agriculture Organisation (FAO), the Secretariat of the Convention on Biological Diversity (CBD), the Scientific Committee on Problems of the Environment (SCOPE) of the International Council of Scientific Unions (ICSU) and the World Conservation Union (IUCN), including its Invasive Species Specialist Group (ISSG), were also involved in the development of the Conference.

The conference was organised by the Norwegian Directorate for Nature Management (DN), the Norwegian Institute for Nature Research (NINA) and the Norwegian University for Science and Technology (NTNU) and its Centre for Environment and Development (SMU), all based in Trondheim. These are all active in the fields of management, education and research related to biological diversity.

The first of the Trondheim Conferences on Biodiversity in 1993 provided important input from a wide audience to the first Intergovernmental Committee meeting of the signatories of the Convention on Biological Diversity (CBD) that year. Important objectives of the 1993 expert conference were to establish and develop contact and collaboration between scientists and policy makers and to enhance the cross-sectoral and multisectoral dialogue on biodiversity research and management.

The Trondheim Conferences on Biodiversity seek to focus on the multidimensional nature of biodiversity in a comprehensive and coherent way, taking into account that the objectives of the CBD, namely conservation and sustainable use of biodiversity and fair and equitable sharing of benefits derived from it constitute the very foundation for sustainable development. The Conference series will contribute to the enhancement of a solid scientific basis for policy and management decisions needed to implement the Convention on Biological Diversity. This approach was also the underpinning for the 1996 Trondheim Conference.

From Article 8 on In-situ Conservation in the Convention on biological diversity:

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;

Alien invasive species represent a serious problem internationally, affecting not only biological diversity in a negative way, but also human and animal health and production in agriculture, forestry and fisheries. These problems are likely to become more severe in the future, with increasing global trade and international travel, global climate change and changing land use patterns. There are already many examples of direct detrimental and often irreversible effects of alien invasive species on terrestrial, freshwater and marine ecosystems, thus hindering the conservation and sustainable use of biodiversity. Furthermore, significant uncertainty is associated with risk assessment of problems caused by alien invasive species.

There is a large and growing concern internationally for the topic of invasive alien species, and a subsequent need to examine issues such as the scientific knowledge base, risk assessment and management strategies, warning systems, possible legal and incentive measures to prevent and control invasions and monitoring environmental effects.

It was against this background that Norway invited all member states of the United Nations, as well as relevant UN agencies and all national focal points for the Convention on Biological Diversity, to this Trondheim Conference. In addition, relevant institutions and organisations working on issues related to alien species were invited to attend, including a number of international instruments and non-governmental organisations in the field of nature and resource management. The participants included policy makers and scientists in the field of environment, agriculture, forestry and fisheries with experience and interests in the area of invasive species.

The objectives of the Conference were:

- To contribute to the development of a sound scientific knowledge base on issues related to alien species, *inter alia* on ecological and socio-economic impacts, prevention and management of introductions, and control and eradication, thereby contributing to the conservation and sustainable use of biodiversity
- To provide a forum for cross-sectoral and multidiciplinary dialogue between scientists and

policy makers on research and management issues related to alien species, and contribute to ongoing deliberations in other international and national fora

The development of the Conference program was closely linked to the ongoing development of a Global Strategy for Alien Invasive Species, under the auspices of the Scientific Committee on Problems of the Environment (SCOPE).

It was also an aim to link the Conference to other ongoing international efforts aimed at reducing the problems caused by alien invasive species, including those by FAO, the Convention of the Law of the Seas, UNEP, UNESCO, the International Maritime Organisation (IMO), the International Plant Protection Convention (IPPC), the Council of Europe (the Berne Convention on the conservation of European wildlife and natural habitats) and by IUCN and its Invasive Species Specialist Group (ISSG). The issue of alien species is also closely related to ongoing discussions on international trade issues, *inter alia* in the World Trade Organisation (WTO).

The themes discussed at the Norway/UN Conference on Alien Species included:

- Human dimensions of the problem
- Ecology and impact of invasions
- Aquatic aliens
- Agriculture, forestry and invasives
- Vectors of alien species
- Impacts on oceanic islands
- Management measures
- Future issues and follow-up of the Conference

The themes were covered through one opening session, eight thematic sessions (with more than 30 lectures followed by short plenary discussions), one panel debate and one session on follow-up of the conference.

This document presents the report of the Conference Chairman, Mr Peter J. Schei, containing his conclusions and recommendations from the presentations and discussions at the Conference. The text is based on main points from the lectures and the following discussions and the panel debate, minutes taken by the rapporteurs, and discussions in the editorial group. In most cases abstracts and proceedings have been available.

The report does not necessarily represent a consensus among the participants.

In addition to this report, ordinary proceedings from the conference will be produced and published. A scientific book containing selected peer-reviewed papers from the conference is also being planned.

Session 1
OPENING SESSION

Chair: **Thorbjørn Berntsen**, Minister of Environment, Norway

Opening statements were delivered by:

- Thorbjørn Berntsen, Norwegian Minister of Environment
- Marvin Wiseth, Mayor of Trondheim
- Pierre Lasserre, UNESCO
- Jorge Illueca, UNEP
- Peter J. Schei, Conference Chair and for 1996-97 Chair of The Subsidiary Body on Scientific, Technical and Technological Advice for the Convention on Biological Diversity (SBSTTA).

In his opening statement, the Minister of Environment, Mr T. Berntsen, pointed out *inter alia*:

- that he hoped the Conference will create an atmosphere where the participants would be able to update each other in an open and transparent way and get the same access to the latest scientific results, management experiences and policy developments, thereby creating a common ground for future work on the issue;
- his understanding that alien species may cause general problems for ecosystems and for the many services and functions that nature and biological diversity provides us with, and that we should therefore all have an interest in making sure that we have strong and resilient natural systems that can continue to provide us with these services;
- that alien species in many cases has provided and will continue to provide benefits, for example to help feed the global economy, but that we need to ask ourselves whether the benefits of using an alien species would be larger than the costs and the long-term impacts;
- that it is now time to also focus on "biological pollution", and as states are now starting to accept regulations on chemical and physical pollution, it should also be possible to convince them that efforts are needed to reduce "biological pollution";
- that Norway places a lot of importance on a protocol on safe transfer, handling and use of genetically modified organisms - a *biosafety* protocol, and that we in the future might talk of "ecosafety", where we will seek to have safe transfer, handling and use of all organisms, not only those that are genetically modified;
- that we must work together on the issue of alien species with other relevant authorities, not least those responsible for health and for food production; and
- that Norway attaches significant importance to the need for acquiring and making use of the best available scientific knowledge as a basis for setting priorities and taking actions, and that the scientific work to be undertaken must build on extensive

international co-operation and draw upon experiences acquired in all geographical areas.

Ballast water has by some been referred to as "a marine cocktail on the move".

On behalf of Elisabeth Dowdeswell, the Executive Director of UNEP, Mr J. Illueca pointed out *inter alia*:

- that international travel and trade, in addition to climatic variation, will continue to provide opportunities for deliberate or accidental introduction of species into ecosystems, and that when a species enters an ecosystem in which it previously did not occur, it can either adversely disturb and disrupt ecosystem processes or have positive effects;
- that like invasive/alien species, introducing genetically modified organisms might present unique risks because "contained" laboratory results alone provide a poor guide to their behaviour, population dynamics, ecological impacts and potential socio-economic effects, and that accordingly, the need for regulations and guidelines related to the release of such organisms have been felt world-wide at country, regional and international levels, and hence the CBD work on a biosafety protocol and the complimentary work of UNEP on International Technical Guidelines for safety in Biotechnology, adopted in December 1995 in Cairo, and the need for their implementation at national, regional and global level;
- that the intent of the negotiators [of the CBD] in including the obligations in Articles 8 (g) and 8 (h) is for the Contracting Parties to the Convention to approach the potential environmental and health risks of alien/invasive species and LMOs in a reasonable precautionary manner, and that the approach should be based on the assessment and subsequent regulation, management or control of the risks assessed;
- that history teaches us many lessons regarding the releases of early adventurers, and about releases that may be commissioned or occasioned by our latter-day scientists, agronomists ecologists or collectors, for example (i) that it is absolutely vital that states be careful in the further introduction of invasive species, and that the States most vulnerable to such invasion are the ones which have already suffered, in particular island nations, (ii) that what must be stressed again and again is the fact that once an invasive species has taken hold, eradication can be very expensive or even impossible using current methods and (iii) that if a damaging introduction does occur, quick action is vital to control it, and that in particular, it may be possible to eradicate an invasive plant before it spreads far; and
- that as an environmental historian, he firmly believes that much greater attention has to be given to the historical accuracy of the geographical origins and introductions of exotic species, not least as geographical origins become blurred over time.

In his opening statement to the Conference, Mr P. Lasserre of UNESCO emphasised *inter alia* that:

- Biodiversity is an area of priority importance for UNESCO, and with its interdisciplinary international activities like the Man and the Biosphere (MAB) Programme and its World Network of Biosphere Reserves, and the Intergovernmental Oceanographic Commission (IOC), UNESCO supports the implementation of the Convention on Biological Diversity.
- It is the opinion of UNESCO that although the natural sciences and scientists have a crucial role to play in assessing and guiding decision making regarding alien species, that the process should be a transparent and democratic one allowing for a larger number of stake holders to express their views and opinions.
- If we accept that uncertainty and risk are two fundamental characteristics associated with alien species, we will also have to accept that experts and scientists will not always be able to provide conclusive recommendations built on consensus.
- Introduction of alien species will of course never be an entirely well managed affair. Based on the motive of private gain or scientific curiosity, there will always be private individuals who are prepared to brake the most stringent rules and regulations.
- Effective policing and monitoring will for various practical and economic reasons also be very difficult and costly to carry out.
- International protocols regarding the transfer and introduction of alien species might be necessary, but decentralised self-control might, in the long-run be more efficient. Self-control is part of the precautionary principle putting the burden of proof on those favouring the introduction.
- UNESCO are integrating ethical considerations related to environment and believe that the ethical aspects related to the alien species problem need to be studied more in detail and for this purpose, UNESCO offers to host a Forum on Risk Assessment of Alien Species which will be available on our Internet based MABnet.

In addressing the Conference, the Conference Chair, Mr P.J. Schei, said *inter alia* that:

- the issue of alien species must be put higher on the international agenda
- when interpreting article 8 (h) of the CBD, focus should be on ecosystem borders more than on state borders;
- we must address the driving forces behind loss of biodiversity through alien species, for example with

regard to the (i) increased free trade and subsequent decrease in border controls (and subsequent need for close co-operation with trade authorities internationally, in particular the WTO, as well as nationally), (ii) increased international travel and tourism and (iii) lack of knowledge as well as of adequate methods and instruments for controlling the problem;
- immediate action is highly needed, but we must be humble when approaching the complicated and complex issue of alien species control;
- we must strike the right balance between importing beneficial aliens and fighting harmful invasives;
- there is a need for further research, but we must build on the work done not least by SCOPE, but also by IUCN and others

Mr Schei also reiterated and elaborated the following points made by the Minister of Environment
- that more focus needs to put on "biological pollution" in general,
- that LMOs are a subset of alien species, although the concerns related to aliens at the subspecies and genetic level are different from those at the species or ecosystem level,
- that the concept of biosafety should be broadened to the term "ecosafety" and
- that a scientific basis with the best available knowledge is needed to implement the CBD.

He pointed out, however, that we still lack much knowledge and that the precautionary principle must be applied, albeit not *"ad absurdum"*.

The Conference will enable a number of prominent scientists to update us in the area of alien species, and we may all benefit from being lifted to the same (higher) level of information - or confusion, if one should want to express it that way.

Session 2
INTRODUCTORY NOTES
Session Chair: **Peter J. Schei**

Invasive species problem - an overview
Rob Hengeveld, Institute of Forestry and Nature Research, The Netherlands

Management decisions about the acceptance of an introduction and/or action plans to eradicate an alien species should be based on more or less precise predictions about the potential of invasives in a specific environment.

There are several problems concerning predictions of how a specific biological invasion is going to develop When dealing with invasions we encounter both theoretical and practical challenges.

Prediction of the progress and consequences of a biological invasion in a quantitative way is not possible. There are possibilities of making analytical models, but adequate estimates of variables are not possible before an invader has been introduced and is actually spread. However, sufficient independent empirical data (life history, survival rate, fertility rate) are available only for relatively few species in order to reconstruct "old" invasions.

Equations in such models show how the variables interrelate, which practical difficulties of measurement should be solved, and how an invasion can be stopped during its progression. These models can therefore provide some support for actual manipulation of an invasive species in the field.

More qualitatively it may be possible to understand why species in a specific environment might be favoured and dominate a local habitat, as well as why some species run an increasingly greater risk of extinction. Qualitatively an estimate of what will happen to the local biodiversity on a spatial dynamic scale is possible even taking into account that invasions usually are non-linear in an non-uniform area.

Points from questions and comments:
- The problems of prediction and risk analysis raise the question of whether it is possible to do more with qualitative predictions, and whether it is possible to use different approaches in handling deliberate and accidental introductions.
- Regarding the amount of resources needed for adequate qualitative predictions, which was seen as difficult but realistic issue, it was pointed out that the problems with invasive species have so far been largely neglected, but that we have many

ideas on how to handle a lot of the occurring problems.

The SCOPE initiatives: The background and plans for a Global Strategy on Invasive Species

Harold A. Mooney, Stanford University, USA

Alien species (non-indigenous, introduced, exotic) species occur in places different from their area of natural distribution Alien species that are aggressive, or threatening, are termed invasive aliens or invasive species.

Our responsibilities with regard to problems caused by alien species are formulated in article 8 (h) of the CBD. However, we are at present not in any way equipped to meet these obligations

We should be concerned with regard to alien species for the following reasons:

- if successfully established, alien species have a good chance of becoming invasive
- invasive aliens (accidental as well as purposeful) can cause extinctions and disrupt ecosystem processes, *inter alia* leading to short and long term losses of ecological services and economic benefits
- the world's biota is becoming homogenised

Ecosystem impacts of invaders include the altering of community structures, biogeochemistry, fire regimes, geomorphology, hydrological cycles and community interactions and the acceleration of erosion.

One person's pest is another's livelihood - example of *Echium plantagineum*

- By cattle ranchers it is called *Patterson's curse*
- By beekeepers it is called *Salvation Jane*

The problem of invasive species can only be expected to get worse, not least due to growing human populations and increases in ecosystem disruptions, increasing global commerce and global change. Consequently, management, e.g. of crops, forests, rangelands, nature reserves, will become an even bigger challenge, as biotic components, i e. the invaders, are continually changing at a rate higher than the background rate and the environment is changing to a greater extent than historically.

Against this background, the Scientific Committee on Problems of the Environment (SCOPE), which is a part of the International Council of Scientific Unions (ICSU), is developing a Global Strategy for Alien Invasive Species. Such a global strategy will include proposals for action related to the following components:

- knowledge update - getting the science right and incorporating new findings into a general framework
- early warning systems - improved information transfer between countries and development of a global data base
- rapid assessment of the status of invaders
- comparative risk analysis - "guilty until prove innocent"
- costs of invasive aliens - need for knowledge of the full ecological and economic impact of invasives and of their control, including on loss of services and on biodiversity, human health, agriculture, forestry, etc.
- uniform treatment of all types of alien species, including exotics (e.g horticultural and pet imports), biocontrol agents and genetically modified organisms (GMOs)
- increased education about invasives at all levels
- development of new laws and other instruments, including accountability (liability, insurance and bonding), international treaties and protocols and sector responsibilities and codes of conduct

In the building of a global strategy, partnerships are to be developed with relevant actors in science, conservation, management, education and communication, intergovernmental bodies, economics and international law.

Preventing biodiversity loss to alien species: The global role of the IUCN Invasive Species Specialist Group (ISSG)

Michael Clout, University of Auckland, New Zealand (Chairman of ISSG)
Sarah Lowe, University of Auckland, New Zealand (ISSG Co-ordinator and editor *"Aliens"*)

The threats posed by introduced species to global biodiversity are immense, insidious and ever-increasing. There is therefore an urgent need for increased awareness of the threats from introduced species, documentation of effects and remedies, and concerted global action to minimise further biological invasions.

The Species Survival Commission (SSC) of the World Conservation Union (IUCN) has responded by setting up the Invasive Species Specialist Group (ISSG), to focus on the conservation impacts of ecologically aggressive introduced species. Its mission is to reduce the threats posed by invasive species to native biodiversity, through increasing awareness of invasive species and means of controlling or eradicating them Overall focus is on oceanic islands.

The ISSG publishes the twice-yearly newsletter *"Aliens"* on invasive species, containing reports,

reviews, news and updates on invasive species problems or control successes.

The group is preparing policy guidelines for prevention of loss of biodiversity through biological invasions. Draft guidelines were distributed for discussion at the conference, and will be presented at the World Conservation Congress in Montreal in October 1996. The goals of the guidelines are (1) to prevent the introduction of new organisms with invasive potential, (2) to ensure monitoring, and thus early detection, of newly-arrived organisms and (3) to facilitate eradication or control of existing invasive species using best available methods. The draft guidelines include proposals for possible actions related to species listings, quarantine and screening protocols, contingency plans, establishment of "Superfunds", development of legal and economic instruments and education. The guidelines are intended to complement the Global Strategy on Invasive Species being developed by SCOPE.

Another ISSG project is the planned creation of a "global database of invasive species", a computerised global listing of invasive species known to significantly threaten conservation values, along with their biological characteristics, history, distribution, habitat associations, control methods. The ISSG is also developing a Home Page and a Listserver on the Internet for increased and improved information and discussion.

The efforts of ISSG should be supported. Specifically, funding is needed for this group to provide assistance globally in the area of information dissemination, database creation, preparation of voluntary guidelines and interdisciplinary efforts to improve alien species policy, with priority attention to countries most in need of such assistance.

Points from questions and comments:

- It was pointed out that capacity building in developing countries is extremely important also with regard to alien species.
- Information materials must also be distributed in written form, i.e. not only through Internet
- The database and guidelines should be made available on the new register on Biosafety which UNEP is now launching.

Session 3
HUMAN DIMENSIONS

Session Chair: **Peter J. Schei**

The lag effect during invasions: Biological, management, and policy

Michael Soulé, University of California, USA

Today we consider habitat destruction to be the most damaging factor to biodiversity. However, invasive species may soon be even more important. This is due to a number of reasons, not least that there is decreasing volume of habitats left to destroy, but also because degraded land and aquatic ecosystems is more vulnerable to exotics.

Invaders commonly have a lag period before population growth increases drastically. Three kinds of lags that require various types of management implications have been identified:

- inherent (demographic)
- environmental (changes in ecological conditions that favour the alien)
- genetic (changes which increases the growth rate)

Of these least is known about genetic lags, which often also are practically invisible.

Time is an ally of the invader (if it manages to establish).

The likelihood of a population to genetically adapt to the environment (not necessarily as a result of changes in the environment) is proportional to population size: The larger the population size, the more likely it is to genetically adapt to the local situation and become even more invasive.

The policy implications of present knowledge, and lack of knowledge, are several.
The most effective form of protection against invasives is a diverse and healthy assemblage of native species. For instance, habitat destruction and fragmentation may very well favour weedy invasives, and removal of predators can provide easy access for exotics. Furthermore, other environmental changes such as removal of livestock from ecosystems with exotic weeds could lead to exploding growth of the weeds.

It is important to utilise the lag times of invasives, and deal with founder colonies before explosive growth occurs. However, past performance of an invasive species can be a poor predictor of its future potential for population growth and range extension.

Future climate change is likely to favour established invaders, including pathogens and disease vectors.

Hence, careful monitoring programmes that allow early detection are crucial.

Time lags has implications for vector management, and practices such as inspections and quarantine will decrease potential for further introductions of previously established exotics (and preventing new genetic stock being added to exiting exotic populations), and it will serve to slow the spread of already established species. Key issues for management and policy approaches are the precautionary principle and promptness of action.

Species invasions and the displacement of cultural and biological diversity

Vandana Shiva, Research Foundation for Science, Technology and Natural Resource Policy, India

Biocultural invasiveness has two dimensions - cultural and biological. The two dimensions cannot be fully isolated, since culturally invasive strategies also displace biodiversity and biological invasions can displace diverse cultures by closing agricultural options.
However, for analytical purposes it is useful to divide invasive species phenomena into three categories:

- Culturally invasive, but biologically non-invasive
- Culturally non-invasive, but biologically invasive
- Culturally invasive and biologically invasive

The Green Revolution is an example of the first category resulting in genetic erosion due to replacement of local varieties by crop monocultures. The new crop varieties were themselves not biologically invasive. However, they do set off a second order species invasion in the form of pests and diseases.

An example of the second category is the introduction of *Lantana camara* as a hedge plant brought from America via Sri Lanka to India. The intent was not to displace local diversity, but it has become a serious problem invading cropped and non-cropped areas.

Genetically modified organisms (GMOs) are examples of the third category. Deliberately released into the environment for application in agriculture, they combine the cultural invasiveness of the Green Revolution with a new level of cultural invasiveness reflected in breaking species barriers without concern for ecological implications.

We should hesitate on large-scale release of GMOs. For instance we do not have adequate methods and equipment to find out if they are becoming invasive. Nor do we have the capacity to follow up properly, for example with monitoring. The long time lags involved also imply a high degree of uncertainty. Which is in contrast to the short-sightedness of many global economic systems, as illustrated for example by the "biological ignorance" or "ecological illiteracy" of the WTO system. Links to patent regimes also exist Against this background, a moratorium on the release of GMOs was proposed.

Conflicts are emerging between barriers to trade (as included for example in the phyto-sanitary section of WTO regulations) and trade barriers to biodiversity.

Points from comments and questions:

- The impact of alien species invasiveness on cultural diversity has not received enough attention, and should be included in this conference under i.e. Management Measures and Follow up and Recommendations.

The great reshuffling: How alien species help feed the global economy

Jeffrey McNeely, IUCN, Switzerland

The global economy brings substantial material benefits. However, the globalization of the economy also substantial costs, including increasing the spread of alien species; yet such costs are rarely considered. It was pointed out that *inter alia* the growth of cities will increase problems related to alien species, since this highly modified environment offers ideal conditions for invasives.

Meetings of the Conference of the Parties to the Convention on Biological Diversity (CBD) offer an important opportunity for dealing with global problems of introduced species, a threat to biodiversity that present is far more urgent and significant than the subset of the problem represented by the introduction of living modified organisms (LMOs).

Four suggestions to contribute to reducing the problem of invasives were presented:

- Stronger linkages should be built between trade issues and the problem of invasions, for instance by making relevant parts of the WTO and national delegations to WTO meetings more aware of the problem.
- A biosafety protocol must address the full problem of invasives rather than only part of it.
- Linkages between invasive species and other factors (including trade issues, globalization, climate change, desertification, etc.) should be illustrated to the general public and through them to our politicians.
- Knowledge from all over the world should be used to develop cost-effective approaches to prevent unwanted invasions and to manage existing problems of invasions.

Points from questions and comments:

- It was suggested that this conference should be able to prepare e.g. a recommendation for the Singapore meeting of the WTO.
- It was suggested - as it appears impossible at this stage to broaden the approach of the Biosafety protocol - that the preamble to the biosafety protocol should encourage future work with this issue to have a broader approach.

Session 4
ECOLOGY AND IMPACT OF INVASIONS

Session Chair: **Eivin Røskaft**, Norwegian Institute for Nature Research (NINA)

Invasive plant species and invasible ecosystems

Marcel Rejmánek, University of California, USA

Seek for simplicity and then distrust it.

Theories are needed that can help us set priorities for the control of introduced invasive species and allow us to predict the risk of future invasions.

Until recently, the pressing question of 'what attributes make some species more invasive' had not been satisfactorily answered. Fortunately, however, a predictive theory of seed plant invasiveness seems to be gradually emerging and the first expert systems for identification of potential invaders have also been completed. It appears that:

- Invasiveness of woody species in disturbed landscapes is significantly associated with small seed mass, short juvenile period, long seed dispersal period and short intervals between large seed crops.
- Vertebrate dispersal is responsible for the success of many woody invaders.
- Primary latitudinal range of herbaceous species is a good predictor of their invasiveness.
- Low nuclear DNA content may result from selection for short generation time may be an ultimate cause of plant invasiveness in disturbed landscapes
- Vegetative reproduction is essential for establishment and short-distance spread of many terrestrial species and more long-distance dispersal in aquatic habitats.
- Analysis of exotic Graminae and Compositae introduced from Europe to California indicates that alien exotics are more likely to be invasive than alien species from the native flora.

Points from questions and comments:

- Screening techniques related to introductions is a complex issue. How to operate in practice? - This is a legislative question.
- Initial behaviour of species will give indications of how serious the problem will be - but initial spreading behaviour is not sufficient - we have to be careful.

Managing insect invasions?

Michael J. Samways, University of Natal, South Africa

As invasives, insects have been hugely successful both in terms of the number of species and in being able to be extremely abundant The great insect variety has come about from low extinction rates in evolutionary history. Many insects are highly mobile For example have densities been recorded of around 20 arthropod individuals landing pr m^2 every day on the tiny island of Anak Krakatau, and this is equivalent to about 50 million individuals arriving each day.

With regard to the human spread of insects, many species readily stowaway on transportation. Excellent stowaways are particularly flies, bugs, bees, wasps, ants, moths and beetles on aircraft and moths and dragonfly on ships. These are free insects, while others hide in or on plants. The magnitude of insect invasions is huge, and the number of new colonists can be high. Hawaii receives, for example, 20-30 new species a year. The invasibility of insects is further emphasised by the convergent accumulation of the same pests on the same type of crop in different parts of the world.

Pest levels world-wide have not decreased, and there is an homogenisation of the global insect fauna. Similar climates accumulate similar invasives Many species arrive, some establish, some die, and only a few become notorious pests. An invasion is described as the establishment, population spread and increase, leading to a keystone role in a new community This new community may be only metres away, but generally it is at a distance of hundreds of kilometres.

Invasions are into buildings, standing and stored crops, and into native ecosystems. Some invasions are of veterinary and medical significance. Damage to natural ecosystems can be direct to plants or to other insects, or can be indirect through competition The serious invaders are characterised by being without natural enemies, highly mobile and often social. Accurate prediction looks to be far off and possibly lies more in genetic nuances of individual species than in generalisation about origin, size, life-history trait etc.

The following points for a "protocol" of invasive pests was suggested:

- It is essential that a country has local expertise that can immediately recognise invasives. It is for example important to educate more taxonomists.
- Know potential invaders and rate their level of threat
- There should always be extremely strict quarantine. Quarantine can be highly effective, but it can rarely suppress invasions.
- There should be an early detection, and immediately attempt eradication or biological suppression.
- Utilisation of eco-climatic modelling, e g CLIMEX, can be very effective in determining to where a new invasive might spread. The key is what is actually happening in other countries.
- Have or contract an effective biocontrol agency to react to possible insect targets

Points from questions and comments:

- What limitations there are concerning following up such a protocol? - It is principally a question of resources and of priorities (the enormous actual and potential economic losses due to alien species were mentioned)
- What about invasive insects threatening natural habitats - and not just agricultural crops? - Our value system is based on production - Economical interests decide what will be done - for example the Argentine ant which has an adverse impact on the fynbos ecosystem.
- If the receiving community is intact, that will be the best defence against invasives

The introduction of species and microbes on disease emergence: Lessons from the past and implications for the future

Ralph Bryan, Centers for Disease Control and Prevention, USA

Emerging infections are new, re-emerging or drug-resistant infections whose incidence in humans has increased within the past two decades or whose incidence threatens to increase in the near future Factors influencing emergence are:

- Human demographics and behaviour
- Technology and industry
- Economic development and land use
- International travel/tourism and trade/commerce
- Microbial adaptation and change
- Breakdown of public health measures.

The first goal in a prevention strategy is to detect, investigate and monitor emerging pathogens, the diseases they cause, and the factors influencing their emergence.

To monitor and prevent emerging vector-borne and zoonotic diseases, one should:

- Monitor the distribution of animal reservoirs and vectors associated with human disease
- Expand applied research on vector competence, distribution of infectious agents among known reservoirs and potential hosts and ecological factors contributing to the maintenance of these diseases in nature.

It was emphasised that (1) there are a number of similarities between alien species and emerging infections, (2) that the problems often will occur together and (3) that close co-operation is needed between the two areas in management as well as in research.

Introductions at the level of genes and populations

Kjetil Hindar, NINA, Norway

Introductions at subspecific levels from genes to populations imply loss of genetic diversity *between* populations. This loss includes homogenisation of the genetic structure of a species, loss of local adaptations, and loss of populations. Direct genetic effects are caused by interbreeding between introduced and native populations, while indirect genetic effects result from altered selection regimes and reduced population size due to disease introductions and ecological interactions. Short term genetic effects of an introduction may be «silent», and even in cases where population fitness is dramatically reduced as a result of interbreeding between incompatible genotypes, the cause of the reduction may not be obvious.

One aspect of uncertainty in assessing impacts of introduced genes into a population is shown by modelling release of transgenic forest trees. With realistic selection coefficients, at least 10 generations - for Norway spruce more than 250 years - are needed before we can say how far a transgene will spread into a natural forest.

Experience from introductions of non-native populations within the fields of wildlife and fisheries management, forestry and agriculture have taught us the following genetic lessons:

- Interbreeding between differently adapted populations may have detrimental, and immediate, consequences ("outbreeding depression").
- Adaptations may occur to other genes and gene complexes, as well as to local environments.
- Morphological similarity, or geographic proximity, should not be trusted as measures of genetic similarity.
- Genetic analyses can aid in finding populations for (re)introductions.
- Extinctions are forever; even at the sub-specific level.

Hindar recommended that:

- Maintain genetic variation *between* as well as *within* populations.
- Accept the shortcomings of making *a priori* predictions of the genetic consequences of releasing non-native and captive-bred populations (including genetically modified varieties).
- Base (re)introductions on the careful genetic (and other biological) analyses, including assessment of the genetic structure of natural populations.

Session 5
AQUATIC ALIENS
Session Chair: **Pierre Lasserre**, UNESCO

Effects of invading species on freshwater and estuarine ecosystems
Peter B. Moyle, University of California, USA

Aquatic environments have incurred numerous invasions and these invasions have often been associated with:
- high levels of environmental alteration resulting from human use
- numerous purposeful introductions
- invading organisms being well fitted to their new environment.

Invading species unquestionably have been responsible for major changes in aquatic ecosystems, including extinction of native species.

Extinctions are most likely to occur when:
- the successful invader is a top carnivore
- the invader carries with it novel disease organisms
- the invaded ecosystem has naturally low diversity
- the invaded ecosystem has been highly disturbed by human or natural factors.

Even though our understanding of ecosystems has increased our ability to predict the impacts of invasions, it still remains poor. Thus, species introductions are likely to have unexpected, usually harmful, consequences (the "Frankenstein Effect").

> The Polonius Principle: Education eliminates accidental introductions.
> "Your bait of falsehood takes this carp of truth"
> *Polonius* (from Hamlet II:1:63)

The rate of invasion into aquatic environments can be greatly slowed by:
- identifying and understanding the sources of introduced species
- education about the dangers of introductions
- incentives to decrease introductions
- not allowing industries that benefit from introduced species to externalise the costs of harmful invasions they cause (i.e., they must have economic responsibility).
- recognising intergenerational obligations (i.e., responsibility to future generations)

Points from questions and comments:
- It was noted that we must not only recognise that the aquarium trade is introducing new fish species, but also numerous other aquatic organisms associated with the fish and water.

Nile perch in Lake Victoria: Effects on fish species diversity, ecosystem functions and fisheries
Richard Ogutu-Ohwayo, National Agricultural Research Organisation, Uganda

Lake Victoria is the second largest lake in the world and about 30 million people in its catchment area depend on it as a source of food and clean water Originally, the lake had a multispecies fishery and very high fish species diversity best demonstrated by over 300 haplchromine species, of which more than 99% were endemic.

During the late 1950s, Nile perch and four tilapiine species were introduced to the lake to improve the fishery of native species which had declined due to over-fishing. Establishment of introduced species was followed by rapid increases in commercial fishery yield from about 100 000 metric tonnes in 1970s to about 500 000 metric tonnes in 1980s. There was also a rapid decline in the diversity of native species mainly due to predation by Nile perch. Haplochromines dropped from about 80% of the fish biomass in 1970s to less than 1% in 1980s, and about 200 species are feared to have become extinct. A comparison of the pre and post perch data shows that Lake Victoria had become eutrophied over this period and lake productivity mechanisms in the lake changed.

- Silicon concentration decreased by a factor of 10, and phosphorus and nitrogen have increased. The consequences of this was that Phytoplankton production doubled and algal biomass increased four to five times. Phytoplankton composition changed from predominance of diatoms to blue green algae.
- The native littoral macrophyte became dominated by the alien water hyacinth.

Some of the management options to curtail ecosystem changes in Lake Victoria would, under the Convention on Biological Diversity include control or eradication of Nile perch from Lake Victoria. The other would involve regulating nutrient inputs into the lake. Removal of Nile perch would not be acceptable because increased Nile perch catches have brought major economic benefits to the riparian countries in form of increased revenue and employment. Also, there are no means of removing the predator from the lake.

Conservation of the endangered species will have to be done outside the lake or in those areas within the lake which are not accessible to Nile perch. Some of the endangered species survive in satellite lakes or refugia within Lake Victoria. Current efforts to conserve endangered species are now geared towards mapping out these areas for protection. Improvement and conservation of aquatic biodiversity

will also benefit from current efforts to reduce eutrophication.

Points from questions and comments:

- If the introduction of Nile perch had not occurred and if one wished to introduce the perch today would this be allowed, or what management procedures would have been used? - Human needs may conflict with article 8 (h) of the CBD.
- Population growth and the demands of the people living in the Lake Victoria area is important in understanding the need for introduction and exploitation of the recourses of the lake. In several cases conflicts between preservation of indigenous species, and the need to feed an increasing population through the introduction of new species can occur.

Invasions in the world's seas: Six centuries of re-organising earth's marine life

James Carlton, Williams College, USA

Ever since humans began crossing the oceans they have transported organisms inside and on the outside of their ships. Many of these early introductions have gone unrecognised, though recent findings suggest their impacts may have been severe (e.g., the effects of an introduced Pacific marine isopod on the mangrove ecosystems of the Atlantic)

The main causes of marine invasions are:

- vessels
- aquaculture and fisheries
- other forms of intentional/accidental releases (e.g. as control agents)
- scientific research
- canals

Marine organisms are being introduced to new ecosystems at an unprecedented rate via ballast water of ships. More than 3,000 species are transported every day by ballast water. The ballast water of any ship may come from one to several sources and carry hundreds of species from almost every phyla, redistributing them throughout the world's oceans.

Vessels are "biological egg beaters" which shuffle organisms throughout the world's oceans.
While ballast water is an international "biotic conveyor belt", with which we can be said to play a game of "ecological roulette".

The dangers of new invasions via ballast water remain enormous as donor areas change and new areas are developed. For example, in the San Francisco Bay area a new species introduction occurs every twelve weeks, principally via ballast water.

There is an urgent need to doing something immediately. The simplest and most immediate solution may be the open ocean exchange of ballast waters, though this is not without its problems.

Points from questions and comments:

- It was noted that the environmental costs of ballast water are externalised by the shipping industry.
- There has been discussion on a ballast tax, although no initiative has been taken by the International Maritime Organisation (IMO), who must be one to impose any regulations on a global scale due to trade and economic concerns.
- The question of other forms of ballast (e.g., sand, rock) was also brought up, but because water is freely accessible and can be regulated easily at sea such a change would be hard to institute.

The red king crab in the Barents sea

Jan H. Sundet, Norwegian Institute of Fisheries and Aquaculture, Norway

The original distribution of the red king crab is the Bering Sea and north Pacific. As a result of Russian introduction of the red king crab (*Paralithodes camtchatica*) in the 1960's, this species is occupies significant areas of the Kola and eastern Finnmark coastal areas.

The crab stock increased rapidly in 1992 and individuals have now been recorded as far west as Vesterålen. Studies of the king crab in this area show that the population biology resembles that found for this species in its native range in the Pacific. In the Barents Sea, however the crab seem to have a slower growth rate and a greater size at maturation than found in the Bering Sea The introduced king crabs have a higher fecundity than those in the Bering Sea In Norwegian waters the crab shows a near shore distribution.

Since 1994 there has been a limited trial fishery, - a total quota of 22,000 animals, equally divided between Norway and Russia. In the future, the king crab stock may be an important fishing resource for the smallest coastal vessels. There is already a well paying world market for this species and the possibility of a future fishery of significant economic value in the Atlantic.

Due to increased catches since 1992 research and registration regarding the crabs distribution has also increased. Studies of king crab's diet in Norwegian waters are done (mainly small mussels, polychaetes and echinoderms) as a beginning of a larger impact study of the crab on the ecosystem. The impact studies of the crab will be continued as it distributes westwards along the coast of northern Norway.

One possible ecological effect might be introduction of diseases together with the crab. Symptoms implicate bacteria or fungus brought with the king crab can attack indigenous crab species.

Points from questions and comments:

- The extent to which the King crab will become a predator and/or competitor to indigenous Norwegian species should be examined before further invasion occurs. Regulations should be in place to limit further expansion (e.g., a fishery) until proper environmental assessment is undertaken.
- Its one of the first known examples of a deep sea introduction, since the crab can go down to 400 meters and thus represents a threat to what is considered a sensitive biota. There should be plans to assess such possible effects.

The Red Sea-Mediterranean link: Unwanted effects of canals

Charles F. Boudouresque, University of the Mediterranean, France

This presentation focused upon canal systems as an important cause of biological invasions using lessons learned from the building of the Suez Canal between the Red and the Mediterranean Seas in 1869. The opening of the canal caused one of the most important biogeographic phenomenon witnessed in the contemporary oceans: the nearly undirectional flow resulted 300 species of Red Sea and Indo-West Pacific origin invading and settling in the Mediterranean, most of them in the Levantine basin. Most settlers are benthic and demersal species, including fishes.

Even though the canal was constructed more than a century ago, the number of new invaders continues at an exponential rate. No plateau is evident. Invaders now represent about 4% of the Mediterranean species diversity of the Levantine basin.

The near undirectional invasion is likely a result of the relatively lower species diversity of the Levantine basin (i.e. geological history), pre-adaptation of Red Sea species to high salinity conditions necessary to cross the barrier separating the two seas and the often higher sea level (30-40 m) of the Red than the Mediterranean Sea.

Surprisingly, little attention has been paid to the ecological impact of the invaders, both at the species and at the ecosystem level. There is a common opinion, based upon poor scientific data, that the Red Sea species invasion has not resulted in Mediterranean species deletion but rather in species enrichment. However, on the contrary, there is some evidence of drastic changes of abundance and of niche displacements. For example, the invasion of large herbivorous fishes has probably had a strong impact on the functional processes of ecosystems of the Mediterranean, a sea characterised by a low level of herbivory.

Some invaders are now of commercial value, being exploited by local fisheries, but it is unclear whether the total fishery has increased or decreased Furthermore, some species (e.g. the jellyfish *Rhopilema nomadica*) exerts a significant negative impact on fisheries and tourism.

Invasions via canal systems are difficult to control However, possible mechanisms to slow the rate of invasion (e.g. the setting up of lock gates and/or reactivation of saline barriers) should be studied urgently.

Session 6
AGRICULTURE, FORESTRY AND INVASIVES

Session Chair **Gunn Paulsen**, Norwegian Directorate for Nature Management (DN)

Biological pest control and invasives

George Oduor, Kenya Agricultural Research Institute, Nairobi

To solve problems caused by invasive species as pests, governments and different organisations are increasingly turning to biological control, as this strategy is often cheap, ecologically less disruptive than chemical control and can maintain biodiversity

Biological control here means the introduction of a living organism as a pest control agent. To develop and implement such control, it is imperative to undertake an exploratory program in the area of origin of the pest, research on the invasives' natural enemies, conduct careful safety testing and quarantine, and finally perform the introduction

A challenge is the conflicting interests between economic interests and conservation management Suggested recommendations are to,

- increase knowledge on pest impacts and biological control
- form legislation and/or formation of fora to deal with conflicting interests
- increase the knowledge of potential biocontrol
- strengthen quarantine efforts

Points from questions and comments

- Increased use of biological control is due to economic importance and many success-cases Predicted increase in its use is also based on elevated pesticide resistance
- Understanding of the ecology of interactions in the natural environment is important, also for the receiving habitat
- It is hard to assess long-term safety and to predict spread, specificity to host and potential of the introduced biological control agent to adapt to a non-target host A problem in risk assessment is the lag effect and that monitoring of potential interactions has been mainly on crop-plants
- Insects as biological control agents might pose unpredictable spread because of their mobility potential

Climate change and invasive species

Harold A. Mooney, Stanford University, USA

Climate change constitutes together with atmospheric change, land use change and biotic change what is referred to as global change The four dimensions, although operating with different time frames, are interactive and should be addressed in a cross-purposal way Global change also represent factors that are crucial to the potential "success" of alien species.

The current observed increase in atmospheric CO_2 concentration structurally affects ecosystems through increased photosynthesis and water storage This may lead to complex interactions affecting competition, food chains, decomposition and soil biology, which in turn may affect the atmosphere

The basic responses to increased CO_2 concentration varies from C4 plants to C3 plants C3 plants, which encompass most crops, respond to increases in CO_2 concentration by increased photosynthetic activity, while C4 plants, encompassing most weeds, does not respond in this way A possible favouring of C4 plants at the expense of C3 plants may nevertheless be countered by an increase in temperature and changes in soil moisture Our knowledge of some of the ecological responses to an increase in CO_2 is but one step in the long, complex and difficult journey of understanding the implications of global change

The increase in tropospheric ozone has for instance been estimated to lead to an 8% loss of plant productivity in the US Invasions due to global change can be predicted, *inter alia* on the basis of observations made with regard to invasions following local climatic variations Increased invasions of alien species must be expected, and the tide must be stemmed There is a need to read the potential for global change and to enhance our knowledge base for preparing useful predictions with regard to the effects of aliens

Points from questions and comments

- Increase in ecological disturbances following global change may open up for an increase of invasions especially of species with a short life cycle
- International mandates following the different global priority areas may to some degree be conflicting
- The objective of increased carbon sequestration may for instance lead to the development of monocultures and run counter to the objective on conserving biodiversity
- Global biotic change may also increase the pressure on undertaking deliberate releases of alien species in order to restore degraded ecosystems

Forestry trees as alien invaders: The current situation and prospects for the future

David Richardson, University of Cape Town, South Africa

Alien trees are used globally in commercial forestry and agroforestry projects because they might have certain desirable characteristics over indigenous tree species. They may also be introduced to "repair" destroyed indigenous forests, as wind breaks, shade for animals, etc. Many tree species have been moved from the Northern hemisphere to the Southern hemisphere, where *Pinus* spp. has become especially problematic.

Alien tree species may make major contributions to regional economies. However, some cause problems as invaders of natural and semi-natural ecosystems. Furthermore, the magnitude of the problem has increased in the past few decades, partly due to afforestation world-wide.

From looking at the life history of previous introductions, the dynamics of invasiveness may become more clear. The species that cause the greatest problems are generally those that have been most widely planted and for the longest time. The most affected areas have the longest histories of intensive planting.

In a protocol for species introduction, the following elements should be considered:

- benefits of the introduced species and its suitability should be defined
- introduced species should not be introduced into pristine habitats
- introduced species should be taxonomically well characterised
- the performance of the introduced species elsewhere should be assessed
- surveys of the natural enemies of the introduced species should be made
- assessments and monitoring of small-scale test-releases should be undertaken, and case studies should be presented to relevant national authorities

Points from questions and comments:

- In order to reduce the ecological impact of alien trees, a consensus or decision-making that will force the understanding of the need of increased knowledge of forest ecosystems. Together with the previous experiences with introduced trees this knowledge will enable us to predict certain invasive traits.
- At present there appears to be an unwillingness to use less invasive species that are thought to be less profitable.

The IPPC model: Controlling invasive domesticates

Tonie Putter, United Nations Food and Agriculture Organisation (FAO), Italy

The work of FAO as the Secretariat to the International Plant Protection Convention (IPPC) and one of the its sub-programmes to safeguard germplasm movement was used as a starting point. Quarantine action is an important part of pest management called for in the convention. It is important that quarantine action is based on real ecological concerns and does not operate as hidden barriers to trade.

There is currently a shift in emphasis from prohibiting introductions resulting from trade to a focus on risk management strategies. Pest management initiatives are important for the conservation and sustainable use of germplasm and biological diversity, and these specific initiatives may prove more useful in fulfilling these objectives than initiatives to address these concepts at large. There is a need to stress that these broader concepts carries with them a focus on metaphysical values which may vary from individual to individual, and this approach does not necessarily mobilise the right constituencies.

It is important to address the needs of developing countries and to seek realistic approaches rather than the ideal ones. There is also a pressing need to see the different international initiatives in this field in relation to each other and a coalition of these various initiatives, bodies and mechanisms should be prepared and made available for the relevant constituencies at large.

Points from questions and comments:

- The many initiatives to conserve and sustainably use germplasm and biodiversity was pointed out and the question asked to what the objectives of these initiatives could be fulfilled under increasing free trade.
- Needs of people have to come first and more attention has to be given to the resource needs of developing countries in order to enable them to address the issues of pest management.

Control of alien species and genotypes: The Danish and EU experience

Henrik Jørgensen, Ministry of Environment and Energy, Denmark

The Danish Protection of Nature Act, which entered into force in 1992, included for the first time a paragraph on the introduction of alien species. The paragraph regulates the introduction of organisms that do not occur naturally in the environment, although the

definition of "naturally occurring species" here is unclear because of the time perspective.

Three examples of invasive species in Denmark are exemplified by the two plants *Heracleum mantegazzianum*, *Rosa rugosa* and the crayfish *Pacifastacus leniusculus*. Control of these invasive species have been shown not only to depend on legislation, but to a large extend public awareness of the problem. Financial support to encourage use of native species instead of exotics is one of the way of helping to solve such problems.

Points from questions and comments:

- It seems rather meaningless with strict legal instruments and control of GMOs, but not on exotics.

Session 7
VECTORS OF ALIEN SPECIES

Session Chair: **Ivar Baste**, Norwegian Ministry of Environment (MD)

Ecological consequences of spreading of pathogens and genes through an increasing trade in foods

Eystein Skjerve, The Norwegian College of Veterinary Medicine, Norway

The previous speaker asked how we can eradicate a 4 meter high plant - the interesting question regarding pathogens is how to eradicate 10-100 µm micro-organisms?

Food- and waterborne infections a leading cause of disease and death in many poor countries, and food-borne infections are also increasing in the industrialised countries. Examples of pathogens are Salmonella, Campylobacter, *Listeria monocytogenes*, verotoxic *E. coli* and drug resistant microbes.

Spreading of pathogens has been documented through trade on animal feed and fresh foods. The trade pattern is linked to a strong industrialisation of animal production, food manufacturing and free trade, where the driving force has been the possibility for an expansion of international markets.

World trade patterns have changed much recently, and there has also been a rapid increase in food-borne infections in the last decades. The consequences might be serious, threatening the quality of local as well as international food chains.

Establishment of free trade of biological products may be the most important decision taking place in the last part of the 20th century.

The biological effects of trade in foods are very strongly linked to the volume of trade. Establishment of methods for risk analysis is necessary to reduce negative consequences such as the spread of pathogens, reduction of biodiversity in food chains and the spread of alien genes. There is an urgent need to go into the basic mechanisms for the spread and persistence of these genes and micro-organisms in the ecosystems. These mechanisms are related to both molecular and to population/ecological processes. So far, no established risk assessment methods are available.

We need trade, but we should be careful in establishing global trade in fresh foods.

Trade and exotic species introductions

Peter Jenkins, University of New Mexico, USA

In the USA, the cumulative economic losses caused by harmful non-indigenous species, including exotic weeds in agriculture, has as a rough, bare minimum estimate been set at 5.5 to 7.5 billion dollars annually. Yet, no adequate global assessment has occurred regarding the overall impact of unintentional introductions carried through trade. Such assessment is vital because it appears that the increasingly globalized trade pathway is a major contributor to the ongoing biodiversity crisis. In essence, harmful introductions are externalised costs of international trade and represent unsustainable uses of the receiving systems. Current economics rarely account for the costs of these long-term global changes.

To my knowledge, not anyone has as his/her full-time job to look at free trade and exotic species.

Risk analysis must be proactive; it is not sufficient to check imported timber for harmful exotics, the ships that carry the timber may themselves be vectors for exotics. Broad measures such as bans or restrictions of imports may be necessary to protect biodiversity and other interests for those countries that care to do so. Internationally supported incentives may be needed to assist lesser developed countries to assess and prevent harmful introductions.

International law relating to the unintentional importation of harmful exotics through trade is weak. Existing legal instruments have the general potential to protect biodiversity from exotics, but they have lacked strong implementation.

The following measures are strongly needed:

- stronger enforcement of existing national and international laws, and
- new laws specifically intended to protect biodiversity, for example by internalising costs for those responsible for an introduction.

Specifically, it is recommended that the Convention on Biological Diversity (CBD) and its Contracting Parties engage with national and international trade regulation authorities, in particular the World Trade Organisation (WTO), to reduce the threat of harmful exotics. Efforts on this global scale appear critical; otherwise, widely adapted invasive species will further homogenise and degrade the planet.

Points from questions and comments:

- The connection between trade and exotics is an international problem which requires an international solution. Yet, it has so far been a big issue only in the north. How can the south handle this threat, when the socio-economic, educational, ecological and climatic realities are so different from the north?
- One international solution may be to impose taxes on trade, which can provide money for risk analysis in countries that cannot afford it.

Strategies for preventing the world movement of invasive plants

Randy Westbrooks, Department of Agriculture, USA

Preston, in 1960, used the relationship between the number of bird species and area on continents to predict the global number of bird species, if all landmasses were made up by one continent. This predicted number was 2500; the actual number was 8600, because the continents are apart. Preston's extrapolation illustrates how many species we may lose when recent and future world-wide movement of species create a biological Pangaea.

USDA's Animal and Plant Health Inspection Service (APHIS) works to prevent the introduction and establishment of foreign invasive plants in the United States, using the Federal Noxious Weed Act as the legal basis. Strategies to protect the United States and other countries from invasive plants include the production of weed free commodities; pre-clearance of high risk commodities; port of entry inspections; and finally early detection, containment, and eradication of weeds that become established in the United States. APHIS has established a method for pest risk assessment for weeds.

Furthermore, the US Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW) has developed a national strategy to address the problem of invasive plants in a co-ordinated and co-operative way.

A national strategy for weeds must build upon partnership, education and research for:

- prevention (stop introduction, detection, monitoring, laws)
- control (priority through partnership, use of Integrated Pest Management [IPM], eradicate new weeds)
- restoration (return host components)

Currently, ten Federal Noxious Weeds are being eradicated from localised sites in the United States through co-operative projects with affected states.

A future challenge is to raise public awareness in order to prevent intentional releases. The term "biological pollution" could for instance be used to describe non-indigenous invasive species.

Session 8
IMPACTS ON OCEANIC ISLANDS
Session Chair: **Cyriaque Sendashonga**, UNEP

An alliance of biodiversity, agriculture, health, and business interests for improved alien species management in Hawaii
Alan Holt, The Nature Conservancy of Hawaii, USA

The islands of Hawaii are special because of three factors: isolation; a limited number of life forms have colonised the islands; and there is a wide range of suitable habitats available for colonisation. Because of this "invasibility" and a high level of endemic species combined with and increasing tourist industry, special precautions are important. A long-standing quarantine system is in operation, but this strategy had to be improved as the system only takes care of some special groups of organisms.

A strategy was put together by joint efforts of several agencies on state, federal and private level . A plan was based on the SCOPE draft for a global pest management strategy (the draft on aliens species is a good, functional and a possible strategy): (i) background planning and recommendations, (ii) alien species action plan which involved 40 organisations and (iii) co-ordinating group on alien species

A main problem has been to get political support. The strategy adopted to reach the politicians is to make a "scare-report" i.e. a document which clearly spell out the problems that different sectors are up to. The key elements from this work are:

- It is a problem of public awareness
- The issue of alien species must become part of the school curriculum
- The number of alien species in focus must be narrowed down
- Press-targeted campaigns
- Engage the public in finding and controlling pest/aliens

A key point is that a campaign must be continuous to constantly remind people of the problem.

Points from questions and comments:

- How to involve the airline companies, and to bring the information to tourists.
- The campaigns have to be honest and credible, and it is important to provide evidence for that the campaigns are effective.

Biological conservation and invasive species: The New Zealand experience
Michael Clout, University of Auckland, New Zealand

New Zealand represents a group of islands isolated so long ago that some consider it as a continent of its own. It has a flora and fauna with many endemic species, especially birds, and it has received many invaders. The invaders have had multiple effects on the wildlife as well as the flora. The effects are both direct and indirect, and many of the consequences could not have been predicted.

Conservation of biodiversity = management of invasive species.

The management of invasive species have involved techniques like employment of toxins, which have proved effective against mammals, and eradication have been achieved both on small and large islands off the coast of New Zealand. In addition a strategy of considering habitat patches on the main islands as isolated islands has also proved possible. On these "mainland habitat-islands" control of mammals has proved successful.

The instruments to achieve control or eradication have been:

- Legal: The Biosecurity Act with the two main objectives (i) prevent unwanted new organisms by implementing penalties and (ii) manage established pests and the planned Hazardous Substances and New Organisms Bill.

The main message is:

- Management of invasive species is an important aspect of biodiversity management as the effect invasive species is difficult to predict.
- Eradication is possible on islands.
- Invasions on the mainland can be managed through a "habitat-island" approach.
- Prevention of new invasions is important.

Points in questions and comments:

- Island nations have a better possibility to control invasions than mainland nations, but ballast water represents a threat.
- The use of biological control as opposed to toxins can be successful or disastrous.
- Is the speed of introductions reduced? Yes, for some groups.

Invasive species - the Mauritius experience

Wendy Strahm, IUCN, Switzerland

The conservation of biodiversity in Mauritius and other Mascarene Islands is inextricably linked with managing alien species. Both introduced animal and plant species have caused extinctions of the highly unique flora and fauna native to the islands in a very short period of time. On Mauritius over half of the total flora is now introduced, with some 18 alien species highly invasive in native ecosystems, and over 30 more would probably be highly invasive if the first 18 were to be eradicated. Therefore the situation is dire, and it is only with intensive management of both alien animal and plant species (including eradication and control) that the unique flora and fauna of the Mascarene Islands will not follow the same path as the Dodo.

Management measures included:

- Putting up fences to keep large mammals out of small managed reserves (forming "habitat islands").
- Weeding to mechanically remove invasive species, using local labour (in the case of Mauritius, sugarcane workers as well as forestry workers)
- Propagating native plant species to recreate the native plant canopy which in turn shades out the alien species, or helps specific native species which have ceased regenerating due to a variety of factors.

This approach was successful in the small "pilot reserves" under study, but needs to be expanded over larger areas, although funds committed for continuous weeding are needed.

The concept of small managed reserves was extended to the islets surrounding Mauritius, where eventual eradication, as opposed to just control, of some invasive species can be envisaged. This involves local engagement, and the idea is to create a showpiece of what the native vegetation once was like, which people will value more than cutting down the ebony trees for firewood, and which will also provide a source of revenue for eco-tourism.

However, when certain introduced animals, such as rabbits, are eradicated, this may produce a release in invasive weed species. It is therefore important that management plans of the islets as well as mainland reserves take into account the ramifications of removing some invasive species.

Finally, several species which cause terrible damage to Mauritius have not yet, or only recently, been introduced to the neighbouring island of Reunion. Attempts to eradicate that island's recently introduced deer, red whiskered bulbuls and privet must be undertaken before it is too late, and care must be taken that monkeys and pigs never escape into the forest.

Points from questions and comments:

- How can we make politicians recognise that they can benefit from raising the issue of alien plant and animal species? By educating the people (who elect the politicians) about the enormous benefit to themselves of their own wildlife, and how alien species are threatening its destruction.
- How are we going to control alien species in the region now that the southern Africa trade treaty will increase trade volume in the region? There is a need to disseminate work done elsewhere, such as that developed in Hawaii, so that people will not have to reinvent the wheel, but educate quarantine officers and other officials about the problems of introduced species that will come with increased trade.

Session 9
MANAGEMENT MEASURES
Session Chair: **Cyriaque Sendashonga**, UNEP

Costs and benefits of alien species
Jeffrey McNeely, IUCN, Switzerland

"What you environmentalists have got to understand is the destruction of the planet may be the price we have to pay for a healthy economy."

Most purposeful introductions have been done for economic reasons, but usually without a careful consideration of the full costs involved. The parties involved in the introduction earned benefits, but the costs are shared by many persons, not necessarily including those who benefited. Also, different people have different perceptions of what are costs and benefits, which makes the issue less clear. A quantification of these interests can clarify and make decisions easier. A careful consideration of both the costs and the benefits of species introduction often will convince decision-makers to invest more in assessing the potential impacts before allowing introductions and to incorporate more biosafety measures once the species has been introduced.

Who should pay for the preventing of accidental invasions? Examples show that the costs after such introductions may be high and assessments, at least in a broad sense, are possible.

Economic tools for addressing the problem of invasive species could include:
- remove subsidies for introduced species
- provide subsidies for use of native species
- apply disincentives, such as fines and penalties, of an appropriate scale
- design and implement economic incentives to control or prevent invasives.

Economists should be included in projects addressing problems of invasive species, and may contribute in several ways:
- economic analysis can provide a rigorous structure to guide policy-makers, so that relevant factors are not "externalised"
- quantification can highlight areas of debate and uncertainty, especially regarding distribution of costs and benefits.
- mobilise economic instruments to ensure better compliance with programmes to address problems of invasives.

Points from questions and comments:
- Cuts in government budgets will often hit those who work with environmental issues
- Politicians and even the World Bank are often unaware of the costs of alien species, because these have been externalised or ignored when cost-benefit assessment of projects is done.

South Africa's experience regarding alien species: Impacts and controls
Brian J. Huntley, National Botanical Institute, South Africa

Despite its relatively small size, South Africa possesses 8% of the world's diversity of vascular plants, 7% of its birds and 6% of the world's mammal species. Its flora, embracing the entire Cape Flotistic Kingdom, is especially rich with 18 388 species of indigenous vascular plants.

"Send us anything that will grow." (van Riebeeck 1652)

Most of the introduced species came from Europe. Especially severe are "transformers", changing the original ecosystem, such as woody invasive species in the originally treeless funbos. Such invasions is said to be the primary cause of extinction of 58 species and the inclusion of 3 435 surviving species in the IUCN threatened plant categories of the Red Data list of southern African plants.

Pines were planted to improve the hydrological regime. However, later studies convincingly demonstrated that the invasion of mountain funbos catchments by woody species reduced the water yield dramatically.

A program was launched with support from the government and involving the local people, with the aim to clear alien vegetation from catchment in ten different areas of the country. During the first six months of operation, over 33 000 ha had been cleared of aliens, over 6 600 jobs created and over 14 500 person days of training provided.

Introduction of cats on the south islands of Marion and Prince Edward with the intention to control mice turn out to be a threat to sea birds populations. The cat population was reduced with the viral disease feline panleucopaenia, hunting and trapping from 3405 in 1977 to be totally exterminated in 1991. The average cost to kill a cat by hunting in the first years was USD 144, the cost to trap the last eight cats was USD 8 259. The project was successful as the number of breeding birds increased.

Session 9 (cont.)
MANAGEMENT MEASURES
Session Chair: **Peter J. Schei**, DN

Control measures regarding marine invasives
Jarle Mork, Norwegian University for Science and Technology, Norway

The International Council for the Explorations of the Sea (ICES) was established in 1902 and has its headquarters in Copenhagen, Denmark. ICES is an intergovernmental marine science organisation concerned with fisheries conservation and protection of the marine environment in the Atlantic Ocean and its adjacent seas. The 19 current member countries are coastal states of the North Atlantic and Baltic Ocean who by their membership have acknowledged the necessity of international co-operation for the conservation of the marine environment and the rational utilisation of living marine resources.

The ICES "Code of Practice on the Introduction and Transfers of Marine Organisms 1994" which was reviewed, addresses problems related to question of preservation of biodiversity, including:

- the coincident movement of harmful (disease) organisms associated with the host species.
- ecological and environmental impacts of the introduced and transferred species themselves, especially if they escape the confines of cultivation and become established as wild stocks.
- the genetic impact of introduced and transferred species due to the mixing of farmed and wild stocks and to the release of genetically modified organisms.

Being adopted by the ICES Council which consists of national delegates, the Code of Practice reflects the member countries' commitment to international co-operation in the identification and fighting of marine milieu problems. The 1994 version contains five sections:

- Recommended procedure for all species prior to reaching a decision regulating new introductions
- Recommended action after the decision is taken to introduce an organism
- Regulatory agencies to prevent unauthorised introductions
- Recommended procedure for introduction or transferred species which are part of current commercial practice
- Recommended procedure for the consideration of the release of genetically modified organisms

Points from questions and comments:

- The option of using introduced sterile organisms (triploidy) is lacking security as the screening methods are within 80% confidentiality range.

Managing alien species: The Australian experience
Roger Pech, Commonwealth Scientific and Industrial Research Organisation, Australia

The Australian landscape has been transformed by alien species over the last 200 years.

Recent initiatives such as (1) the National Strategy for the Conservation of Australia's Biological Diversity, (2) a series of guidelines for the management of vertebrate pests and (3) a program to develop threat abatement plans, reflect a concerted national effort in the management of alien flora and fauna.

As an island continent Australia has a viable option of effectively preventing the illegal and accidental importation of unwanted species. In addition, ecological criteria which aim to separate beneficial species from those likely to become pests, are an important element of the assessment of legal importation's of exotic species. For existing pests species the management objective can be eradication but because this has rarely been achieved on a continental scale, a more realistic goal of cost-effective sustained management is often necessary. Sustained management requires an understanding of the relationships between pest abundance and the damage it causes.

While there is a substantial body of knowledge on the value of many conventional techniques, the development of new control technology, including (1) use of modern recombinant technology and (2) fertility control for vertebrate pests, and demonstration of its efficacy and integration with existing techniques is the subject of continuing research.

In Australia there has been widespread public acceptance of the role of introduced pest species as threats to the conservation of native flora and fauna. However, public concerns have also been expressed about the ecological consequences of the removal of an alien species once it has become widely established. Part of the solution is to develop management strategies for whole systems, not single species. Another part is a better identification of which processes threaten the conservation of native species. Definition of the symptoms of a declining species and diagnosis of the causes of decline remain areas of major research.

Legal authorities for controlling alien species: A survey of tools and their effectiveness.

Michael Bean, Environmental Defense Fund, USA

A wide variety of legal authorities at the national, sub-national, and international levels exist for preventing or controlling the harmful consequences of the introduction of alien species. Trade controls aimed at preventing the intentional importation of potentially harmful alien species are among the earliest measures tried. A key consideration in the effectiveness of such measures is whether they assume all alien species to be harmful until proven otherwise, or whether they require an affirmative showing of harmfulness before trade may be restricted. Trade restrictions aimed at ensuring that imported products do not carry pests, pathogens, or other species harmful to agriculture or human health are also common and have had significant success. Less obvious pathways for introduction, such as ship ballast water, have been the focus of more recent legal attention. The success of these efforts cannot yet be determined.

Once introduced, alien species have been the subject of a variety of legal measures aimed at controlling their spread or achieving their eradication. Such measures include internal quarantines, requirements that aquaculture facilities be self-contained, and other strategies. The success of such measures has often been less than dramatic. Imposition of legal liability upon parties responsible for introduction of harmful species is a potentially useful though largely untried legal strategy. A tax on classes of activities known to be significant sources of introduced alien species could generate the revenues needed to finance education, inspection, control, or eradication programs.

Points from questions and comments:

- In coping successfully and effectively with introductions, capacity building, exchange of information, and harmonization of quarantine regulations is needed as well as legislation.
- Ongoing initiatives under the auspices of the Berne Convention (on the conservation of European wildlife and natural habitats) are also looking into the issue of alien species.
- Examples of success in the field of alien species are mainly to be found in agricultural pest control and less with effects related to the conservation of biodiversity

International instruments, processes, organisations and non-indigenous species introductions: Is a protocol to the convention on biological diversity necessary?

Lyle Glowka, IUCN Law Centre, Germany

References to non-indigenous species can be traced to a number of international instruments and processes at the global and regional levels, with the citation rate increasing markedly from the 1980s until the present. International organisations are also increasingly involved with non-indigenous species issues. But despite the international community's acknowledgement that the intentional and unintentional introduction of non-indigenous species can lead to ecological damage, the consequent loss of biological diversity as well as potentially huge economic and development losses, the extent to which introductions occur appears to be increasing and suggests controls in many countries are far from adequate.

The ratification of the CBD by over 140 states and regional economic integration organisations suggests that the means may exist to develop a comprehensive global approach to the intentional and unintentional introduction of non-indigenous species. The Convention's "country-driven" nature allows Parties to tailor their own approach to the introduction, control or eradication of non-indigenous species through their national biodiversity planning processes. The emphasis on national action and priority-setting is desirable from several stand points. However, consistency of approach and harmonisation of goals - the results of co-ordination and common priority setting - may be sacrificed without further action by the Conference of the Parties (COP) to the CBD.

A brief survey was given of the international instruments, processes and organisations which have addressed non-indigenous species to date. It was shown that international conventions and agreements often have a poor coverage of the issue, are inconsistent, have low specificity, provisions mainly on protected areas, only one has pre-introduction consultation with neighbouring countries, accidental introductions are rarely mentioned, control and eradication are rarely specified in the regional treaties.

Panel debate

CAN WE COPE WITH INVASIVES?

Moderator: **Ketil Gravir**, Norwegian Broadcasting Corporation (NRK)

Participants: **Harold Mooney**, SCOPE
Sigmund Kvaløy Setreng, The International Forum on Globalization, Norway
Jeffrey McNeely, IUCN
Marcel Rejmánek, University of California, USA
Cyriaque Sendashonga, UNEP
George Oduor, Kenya Agricultural Research Institute, Nairobi
Jeff Waage, International Institute of Biological Control, United Kingdom

In opening the moderator asked if (1) the apparently precarious food situation and concern for world food security, (2) the spread of infectious diseases and (3) increased focus on the growth in world trade could constitute important reasons for why alien species now seem to get increased attention.

In the panel debate, which also included active contribution from the audience, discussion concentrated around the following issues:

- The actual and realistic opportunities and possibilities for preventing and managing alien species and for controlling and eradicating invasive species.
- The role of globalisation and underlying economic forces, related to e.g. changed consumption and production patterns and increased trade, industrialisation and specialisation
- The need for gathering and sharing information about invasive species and management
- The importance of national capacity building and access to necessary resources to appropriately deal with invasive species, in particular in developing countries
- The importance of stakeholder involvement and participation and increased local understanding of the dependence of biological diversity, and information and education needs in this regard
- The need for involvement from economic sectors of relevance to the spread and problems related to alien species, in particular trade, agriculture and forestry
- The need for increased attention on the economic aspects of alien species, including use of the cost/benefit approach and internalisation of actual costs through legal and economic instruments
- The need for increased attention and focus on alien species, and appreciation of increasing awareness and activity in this regard
- The role of science and scientists in order to reduce problems on alien species
- The need for increased accountability and responsibility related to the effects of invasive species

Session 10
FOLLOW-UP OF THE CONFERENCE
Session Chair: **Peter J. Schei**

Research needs
Harold Mooney, SCOPE

I THE KNOWLEDGE BASE - A GLOBAL PERSPECTIVE

1 Human dimensions
- a. Historical perspective on invasions
- b. Ethical issues related to invasives including inter-generational obligations
- c. Invasives and value systems
- d. Socio-economic Issues
  - i. The players
  - ii. Cultural concerns
  - iii. Markets, etc.
- e. Globalization trends

2 Ecology of invasives
- a. Improve our predictive capacity on:
  - i. Transport probability and success
  - ii. Establishment probability
  - iii. Spread potential
  - iv. Displacement capacity
- b. Basis of lags in invasive spread of traits and organisms
- c. Losses of genetic potential due to invaders
- d. The use of experimental approaches to invasion ecology

3 Vectors of invasives. their changing nature
- a. Vector types for invaders including infectious diseases, and their changing nature
- b. Commerce as vectors (shipping, pets, nurseries, agriculture, general)
- c. Impact of international trade agreements
- d. Solutions to the ballast problem
- e. Quantify pathways of invasives

4 Global change effects
- a. Changing land use practices and invasibility
- b. How will climate change and atmospheric change influence invasions and invasibility
- c. Model building for global change predictions on invasives
- d. Development of meaningful experiments on impacts of global change on success of invasives
- e. Conflicts between the aims of climate and biodiversity conventions

II THE NEW TOOLS NEEDED

5 Early warning systems
- a. Examine and compare existing invasives data bases including that of IPPC
- b. Develop or modify existing systems to provide a readily accessible data base indicating the geographic distribution of current invasive species

6 Assessing status of invaders
- a. Develop methods for the rapid and repeatable assessment of the status of invasive in a region.

7 Impact of invaders - analysis and costing
- a. Biodiversity-losses and gains
- b. Ecosystem functioning-losses and gains, e.g. productivity, water quality and quantify, nutrient storage capacity, sediment holding capacity, flammability, disturbance potential, etc.
- c. Human health
- d. Agriculture, forestry mariculture
- e. Full analysis of the health impacts of the increasing fresh food trade
- f. Analysis of the potential dangers of new and changing trade routes
- g. Full accounting of externalities related to invasives
- h. Full analysis of who gains and who loses with invasives
- i. Tax structure in relation to invasive costs

8 Control of invasives
- a. Promotion of the development of new control technologies; chemical, biocontrol, GMO's, mechanical and comparisons among existing methods
- b. Ecological costs and benefits of control
- c. Product yield costs and benefits of control
- d. Conflict resolution in control efforts
- e. Development of disincentives for introductions and reductions of invasive subsidies
- f. Development of swift action team approaches to *beach head establishments of invasives*
- g. Examine and compare existing national quarantine programs and the IPPC process

9 Comparative risk analysis approaches
- a. Inadvertent introductions
- b. Purposeful introductions
- c. Biocontrol agents
- d. Release of GMO's for invasive control
- e. Expansion of current biosafety protocol to invasives

10 Existing and potential legal instruments and other measures (incentives, fees, bonding, etc.) for dealing with invasives.
- a. Comparative country analysis (policies, institutional mechanisms, administrate regulations) and their utility
- b. Analysis of the status and effectiveness of international instruments (treaties and protocols). Are further instruments needed?
- c. Developing new accountability approaches (liability, insurance, bonding)
- d. Instigating new sector responsibility and codes of conduct

11 New approaches to education about invasives
- a. Primary school
- b. General public--losses plus victories
- c. Resource managers

d. Trade organisations and WTO
e. Policy makers including OECD

12 Capacity building and enhancement

a. Technical knowledge exchange (clearing house mechanisms on methods of eradication and control) and Web page development and printed materials made easily available
b. Develop the means of exchanging expertise and the development of short courses on prevention and control of invasives

Who does what on the international scene?

Calestous Juma, Secretariat of the Convention on Biological Diversity

On behalf of the Convention on Biological Diversity (CBD), Juma thanked the Government of Norway for arranging the Norway/UN Conference on Alien Species and for providing this forum for scientists and managers/practitioners to meet and to share ideas and viewpoints.

Juma said that the CBD, which he described as a still young international instrument, is continuously evolving. He pointed out for example that the CBD had evolved from focusing largely on conservation issues at the first Conference of the Parties in 1994 to taking a more holistic approach at the second Conference of the Parties in 1995, integrating also the need for sustainable use and benefit sharing. He emphasised that such a broader perspective was also needed for the complex issue of alien species.

Regarding present processes taking place under the auspices of the CBD, Juma pointed out a number of items of relevance to alien species that will be discussed this year. The most important of these are listed below (figures in parentheses refer to provisional agenda items).

Under the second meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA2) to the Convention 2 - 6 Montreal in September 1996:

- Alternative ways and means in which the Conference of the Parties could start the process of identification, monitoring and assessment of components of biological diversity, as well as processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, in accordance with Article 7 (3.2.1)
- Scientific, technical and technological aspects of the conservation and sustainable use of coastal and marine biological diversity (3.12.1)
- Scientific, technical and technological aspects of the conservation of agricultural biological diversity and the sustainable use of its components (3.9.1)
- Scientific, technical and technological advice on ecological valuation of biological diversity and its components, in particular in relation to access to genetic resources (3.11.1)
- Review and promotion of indicators of biological diversity to be used for assessment of effectiveness of measures taken in accordance with the provisions of the Convention (3.3.1)

Under the third Conference of the Parties (COP3) in Buenos Aires 4 - 15 November 1996:

- Implementation of Articles 6 and 8 of the Convention, which this year will focus on the sharing of experiences (7.1)
- Financial resources and mechanism, *inter alia* in relation to the Global Environment Facility (GEF) and to enabling activities (6)
- Issues related to biosafety, i.e. consideration of the first report of the Open-ended Ad Hoc Working Group on Biosafety, which met in Århus, Denmark in July 1996 (17.1)

Juma said that there were therefore several opportunities under the CBD to raise various aspects related to alien species, not least using relevant provisions of Article 8. He pointed out that several types of output could be generated in this regard, including technical guidelines, harmonisation of international guidelines and funding of relevant activities.

In concluding, Juma pointed out that there is a need for a broad approach to the issue of alien species, as this is a large area with a wide range of consequences of importance to many. There is therefore a need to ensure a good relationship between work under the CBD, i.e. by the Conference of the Parties, and work under other relevant international bodies, including the World Trade Organisation (WTO) and to undertake extensive consultations in this regard. The broad approach to be taken also needs to acknowledge and benefit from work done and experience learned by others. There is also a need to get in place mechanisms for resolving conflicts that may arise, for example in the field of alien species.

Recommendations and follow-up: Concluding remarks from the Conference Chair

Peter J. Schei

As Conference Chair, Schei pointed out that there would be four written outputs from the conference:

- **Conclusions and recommendations from the Norway/UN Conference on Alien Species**, a one page "consensus" document with findings from the conference (included in the beginning of this report)

- **Chairman's Report - Conclusions and recommendations from presentations and discussion at the Norway/UN Conference on Alien Species**, a guide for policy makers (this document)
- **Proceedings from the Norway/UN Conference on Alien Species**. containing full proceedings from the conference (to be published August 1996)
- **Alien species and the Convention on biological diversity** (draft title), a peer reviewed book containing the scientific presentations at the conference (planned to be published in 1996/97)

Schei stated that the follow-up of the conclusions and recommendations from the conference primarily must take place at the national level. All Parties to the CBD present at the conference were therefore recommended to bring these conclusions and recommendations back to their respective national authorities for information and eventual follow-up, according to national priorities, plans and budgets. In addition, the conference organisers will distribute the above material also to other Parties to CBD and to relevant international organisations and institutions.

Furthermore, the results from the conference will also be tabled for information for SBSTTA2 in Montreal in September 1996, and will be presented in a statement in a statement from Norway at COP3 in Buenos Aires in November 1996. And while it is up to each Party delegation at SBSTTA2 and COP3 to use the conclusions and recommendations from the conference as they wish, several Party representatives have already indicated that the issue of invasive species should be put on the working program and agenda for SBSTTA. Schei pointed out, however, that that of course is up to the COP to decide on.

The results from the conference will also be integrated into the SCOPE/UNEP initiative on developing a global strategy and action plan on invasive species. IUCN's work on guidelines for dealing with invasive alien species will also benefit from the findings and results of the conference.

Under this agenda item there was also discussion and approval of the conclusions and recommendations from the conference, to be presented as a one page consensus document with findings from the conference. A draft version of these conclusions and recommendations had been developed by the Report Advisory Group, and was presented by the Conference Chair. Following some discussion and the inclusion of some suggestions for improvements of the text, a set of conclusions and recommendations from the conference were approved. The full text is included in the beginning in this report.

As Conference Chair, Schei also used this opportunity to thank all those who had contributed to the conference, including in particular UNEP and UNESCO, the speakers, the session chairs, the International Advisory Group, the Conference Committee, the Conference Secretariat, the rapporteurs, those handling information and media and the representatives from media.

Closing address

Hallgeir Utne Hatlevik, Norwegian Ministry of Foreign Affairs

Utne Hatlevik, who is political adviser to the Minister of trade and shipping, referred to alien species as having been identified as one of the largest threats to biological diversity and said that this biological diversity in many respects is a prerequisite for sustainable development. Through the conference Norway therefore hopes to have placed alien species on relevant agendas world-wide, not only in the environmental field, but also in areas such as food and health security and trade transportation.

The large and growing service sector is important, not least trade, transport and tourism, as vectors for alien species, thereby causing external effects we want to minimise. It was also pointed out that with today's modern system of world trade and transport, alien species are to an increasing degree travelling faster and in increasing numbers.

A critical factor for government representatives and decision makers is that the risks and uncertainties involved are significant. In this regard a solid scientific basis must be a central element for international work on alien species. At the same time, it might be necessary to use the precautionary principle, a principle Norway has been a strong advocate of internationally, to a larger extent than today, albeit cautiously and not as a guise for protectionism. Furthermore, sectoral integration is crucial both at the international and national level, also for reducing problems caused by alien species. Relevant fora on the international scene in this regard include IMO, FAO, WTO and the CBD.

There is an ongoing trade and environment debate in many international fora, but the issue of alien species has not been placed under the magnifying glass in this context. There is a growing awareness of the problem on the trade side, but though there is a clear connection to trade in both goods and services, Utne Hatlevik said that it would seem that the best way to address the problem is through environmental agreements. It is also necessary to take a closer look at the issue of alien species in the trade context, and it is important that the global trading system, based on

the rules of the WTO, does not hinder measures to contain alien species where necessary. Relevant in this regard is the provision in Article 20 of GATT to make exceptions for measures that are "necessary to protect human, animal or plant life and health".

It is the view of Norway that an open, equitable, non-discriminatory and predictable multilateral trading system that is consistent with the goals of sustainable development can lead to a more optimal distribution of the world's resources. We must, however, ensure that the rules of the trading system, or modifications to the rules, contribute positively to environmental and resource management policies, while maintaining open trade. The WTO should also discuss how to avoid possible negative consequences of further trade liberalisation. Norway is also of the view that evaluation of the environmental consequences of trade policies, including trade liberalisation, and of other measures affecting trade is essential as a basis for market access negotiations.

Norway will strive to ensure that the upcoming WTO Ministerial Conference in Singapore in December gives guidance in the area of trade and environment. For example should the WTO be supportive of efforts to internalise environmental costs.

Other meetings held during the conference

Parallel to the Trondheim conference on alien species, a number of meetings were held related to various aspects of alien species. The meetings held include the following:

- the development of a global strategy and action plan to deal with the issue of invasive species (convened by SCOPE)
- the role of the IUCN Invasive species specialist group (ISSG) (convened by ISSG)
- needs of developing countries related to invasive species (co-ordinated by Malawi)*
- action needed at the national level (convened by USA)

* A statement developed at this meeting, containing "Suggestions from the developing countries for possible inclusion in the recommendations for *post* Trondheim", is found in ANNEX I.

ANNEX I

SUGGESTIONS FROM THE DEVELOPING COUNTRIES FOR POSSIBLE INCLUSION IN THE RECOMMENDATIONS FOR POST TRONDHEIM

Co-ordinated by Z. M. Vokhiwa, Ph.D., MALAWI

Trondheim 4. July 1996

The Session Chair and the Conference Chair;

Our appreciation is extended to you and your organising committee for inviting and hosting us here in Trondheim to this important meeting on **alien species**. Please accept our sincere gratitude.

Now that the conference is about to wind-up tomorrow, the representatives from the developing countries would like to make the following observations and suggestions for consideration for inclusion in the final conference recommendations for the way ahead past Trondheim.

Developing countries suggest that the Trondheim conference should endeavour to develop and put in place mechanisms including:

1 Capacity building and enhancement

- Institutional strengthening of both national and regional levels in customs, trade, tourism, police and other relevant sectors dealing with alien species in one way or the other
- Research
- Training
- Develop control and monitoring capabilities

2 Public awareness/education

- Awareness campaigns to policy-makers, politicians, and technicians on the importance of addressing alien species and their invasiveness
- Communication enhancement
- Publications/pamphlets and booklets
- Internet
- Fax
- Other improved communication technologies.

3 Technology transfer on non-commercial basis

- Appropriate technologies to deal with alien species and their invasiveness.

4 Resource mobilisation

- Exchange of personnel and experts.

5 Co-ordination and partnership between the south/ north should be enhanced within the context of the developing countries

- Ensure multi-sectoral approach in dealing with alien species and their invasiveness
- Develop ways and means/suggestions to narrow the gap between the North and the South in terms of research, information exchange and technology transfer.

6 **Poverty alleviation and provision of alternatives to curb the threat and depletion of biodiversity through alien species and their invasiveness**

7 **Develop strategies which will ensure that alien species strategies and initiatives benefit the developing countries in terms of their socio-economic and sustainable environmental management both at national and regional levels; utilising a bottom-up approach**

8 **Facilitate the strengthening of national and regional consultations on alien species**

9 **Develop an internationally legal binding instrument to control and monitor the transboundary movement of alien species**

10 **Develop an interim measure "technical guidelines on alien species" for use by both the north and south**

11 **Mandate one of the international organisations such as UNEP, FAO, UNESCO, IUCN, UNDP to be designated the responsibility to facilitate and co-ordinate alien species strategies and initiatives in developing countries including inventory, assessment, monitoring and evaluation at both national and regional levels**

Participating members

1.	Benin	-	Owolabi, Lucien
2.	Burkina Faso	-	Bance, S.M.
3.	Ethiopia	-	Kabede, Solomon
4.	Equatorial Guinea	-	Ayong Otunga Avomo, S.
5.	Gambia	-	Camara, Almamy
6.	Ghana	-	Oduro, William
7.	Kenya	-	Mumella, Timothy
			Odour, George
8.	Madagascar	-	Rafalimanana, Holy V.
9.	Malawi	-	Vokhiwa, Zipangani
10.	Niger	-	Ada, Laouali
11.	Uganda	-	Ogutu-Ohwayo, Richard
12.	Zimbabwe	-	Chidziya, Edson

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