JUNE 2009 • Volume 4 — Issue 1

business .2010

A MAGAZINE ON BUSINESS & BIODIVERSITY

CBD
Secretariat of the Convention on Biological Diversity

SPECIAL FOCUS ON INVASIVE ALIEN SPECIES

INVASIVE SPECIES ON THE MOVE

Healthy Business Practices Help Prevent Invasive Alien Species

Developing a Pet Trade Toolkit

COMBATING INVASIVES IN JAPAN

Tomatoes and the Bumble Bee

INVASIVES IN INDUSTRY

Invasive Alien Species and the Aquarium Industry

business .2010
JUNE 2009
Volume 4 — Issue 1

Director of Publication
Ravi Sharma, *ravi.sharma@cbd.int*

Editors
Marie Aminata Khan, *marie.khan@cbd.int*
Neil Pratt, *neil.pratt@cbd.int*
Johan Hedlund, *johan.hedlund@cbd.int*

Layout and Design
Perennia

Produced with the generous financial contribution
from the Government of the Netherlands.

Archive
www.cbd.int/business/newsletter.html

Comments and suggestions for future columns are welcome and should be addressed to the editor.

Secretariat of the
Convention on Biological Diversity
413 Rue St. Jacques, Suite 800
Montréal, Québec, H2Y 1N9 Canada
Tel. +1 514 288 2220 / Fax: +1 514 288 6588
www.cbd.int
secretariat@cdb.int

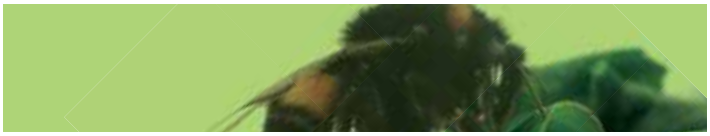
Convention on Biological Diversity

UNEP

Printed on Rolland Enviro100, which contains 100% recycled post-consumer fibre, is EcoLogo, Processed Chlorine Free and manufactured using biogas energy.

SECTION I /
INVASIVE SPECIES ON THE MOVE

SECTION II /
COMBATING INVASIVES IN JAPAN



SECTION III /
INVASIVES IN INDUSTRY

SECTION IV /
VISUAL DATA

Business Depends on Well-maintained Biodiversity

by **Ahmed Djoghalf** • Executive Secretary of the Convention on Biological Diversity

Invasive alien species (IAS) are species whose introduction and/or spread outside their natural habitats threaten biological diversity. While only a small percentage of organisms transported to new environments become invasive, their negative impacts on food security, plant, animal and human health and economic development can be extensive and substantial.

The problem of invasive alien species continues to grow, essentially due to global trade, transport and travel, including tourism, at an enormous cost to human and animal health and the socio-economic and ecological well-being of the world. The annual environmental losses caused by introduced agricultural pests in the United States, United Kingdom, Australia, South Africa, India and Brazil have been calculated at over US$ 100 billion. One study showed that the global estimation could be US$1.4 trillion, which represents 5% of the global GDP.

Photo courtesy of *Ryan M. Moody*, www.flickr.com/littoraria

Relevant to every type of ecosystem, the issue of invasive alien species is central to the achievement of the three objectives of the Convention on Biological Diversity – the conservation of biological diversity, its sustainable use, and the fair and equitable sharing of benefits arising from the utilisation of genetic resources. As we are only one year away from 2010, the International Year of Biodiversity, and the target date for the 2010 Biodiversity Target, urgent action is needed to tackle the threat of invasive alien species.

As all businesses, irrespective of size, sector and location, ultimately depend on biodiversity, they can have a major direct and indirect impact on biodiversity, as they possess biodiversity relevant knowledge, technical resources and managerial skills. In turn, how companies manage biodiversity is, increasingly, seen as relevant to their bottom line.

It is our hope that the articles in this special issue of the *Business.2010* newsletter on invasive alien species commemorating the 2009 International Day for Biological Diversity, will provide an opportunity for businesses to consider healthy business practices in order to reduce the impact of these invasives on agriculture, forestry, fisheries, human health and on wild biodiversity, which is often a basis of livelihoods of people in developing countries.

I would like to thank all the contributors to this special issue highlighting the role of industry in the introduction of invasive alien species.

Photo courtesy of *Molly Campbell*, www.flickr.com/myrcell

SECTION I /

INVASIVE SPECIES ON THE MOVE

Examining the threat and spread of invasive alien species through a variety of pathways

Healthy Business Practices Help Prevent Invasive Alien Species

INTRODUCTION OR SPREAD OF INVASIVE SPECIES CAN BE MITIGATED BY ADOPTING BETTER PRACTICES

by **Duan Hui** ● Ms. Duan Hui is the Invasive Species Project Officer, for The Nature Conservancy China Program in Beijing. She can be contacted at: *duanhui@tnc.org.cn*; *www.nature.org*

Invasive alien species are non-native species of plants, animals or microorganisms whose introduction into a new ecosystem threatens biodiversity and poses significant challenges to food security, human health, trade, transport, tourism and other economic sectors. These species can rapidly and seriously degrade natural habitats by competing with native species, altering gene pools through hybridization, changing species composition, and altering ecosystem processes such as nutrient cycling. Invasive species are recognized as one of the greatest threats to the environmental and economic well-being of our planet[1].

A 2008 study suggests that in the Great Lakes region of the US, annual economic losses due to invasive alien species introduced by shipping amounts to $200 million

A major source of invasive alien species is increasing international trade. As the global financial crisis deepens, many national governments are taking actions to stimulate the economy. These measures often involve the development of industrial and transportation infrastructure, which can further increase invasive species introductions, thereby setting the stage for potentially rampant environmental disasters and greater economic loss. Sometimes this is done intentionally, at other times quite unintentionally. For example, pet, aquarium, aquaculture and horticulture trade are key pathways related to intentional species introduction. The main unintentional pathways are transportation ships – either on the outside of the ship hull or within a ship's ballast water – and travel passengers by airline, train, ship or even on foot. Either intentionally or unintentionally, the risk of introduction or spread of the invasive species can be mitigated if every enterprise adopts better practices.

HOW CAN BUSINESSES ACT TO PREVENT INVASIVE ALIEN SPECIES?

While most businesses have not noticed the negative impact that invasive alien species have on the economy, there are numerous examples of businesses suffering from these invasions. A 2008 study suggests that in the Great Lakes region of the U.S., the annual economic loss due to invasive species introduced by shipping amounts to $200 million dollars because invasions diminish the ability of the natural ecosystem to support fisheries, raw water uses (e.g., for drinking), and wildlife watching[2]. In Hawaii, a new law imposes a 50 cent tax on every thousand pounds of goods shipped via air cargo to prevent invasive species. As the result, shipping goods via air cargo has become more expensive, thereby increasing the cost to local businesses. In the end, businesses cannot avoid the increasing economic loss brought about by invasive alien species, but they can play an essential role in addressing the challenge of combating these aliens, especially in the industries associated with introducing, promoting and observing invasive species, such as trade and tourism. Business can have a positive attitude in addressing the invasive species issue, viewing it as another factor in their sustainability efforts.

Businesses and conservation groups should seek opportunities for engagement. Enterprises could be involved in activities to raise public awareness and improve policy or government regulation in preventing invasive alien species. For example, a local tourism company in Lijiang, China, arranged a half-day field trip for summer camp students to identify invasive species and their harmful impact on an inland lake there. Officials from the local forestry bureau were invited to be trip coaches to teach students what they themselves had learned from a former training organized by The Nature Conservancy, an international NGO. As another example, The Continental Dialogue on Non-Native Forest Insects and Diseases is a project cultivating and catalyzing collaborative actions among diverse interest groups to abate the threat from non-native insects and disease to North American forests. Participants include representatives from enterprises, universities, governments and NGOs who work to develop and implement market-based strategies to encourage best management practices, communications and marketing approaches to raise public awareness, and legislative strategies to improve public policies. A recent achievement of the Dialogue is the creation of a website spearheaded by The Nature Conservancy on preventing or reducing the spread of pests by not moving firewood[3].

Moreover, as part of the Dialogue's prevention efforts, a working group including industries, universities and non-profit groups negotiated a set of consensus recommendations for the Animal and Plant Health Inspection Service of the United States Department of Agriculture on a pending regulation to minimize the risk of additional pest introductions via the pathway of nursery stock. This set of consensus recommendations was adopted in October 2007[4].

Another engagement opportunity is to cooperate in the control and eradication of existing invasive alien species. In Hawaii, two leading conservation firms from New Zealand–Prohunt and LandCare Research – assisted Nature Conservancy staff in carrying out a demonstration project to detect, monitor and control invasive animals. Prohunt, an animal management company, offers integrated tracking, monitoring and hunting methods. The Conservancy looks to Landcare Research for guidance in using proven statistical techniques to evaluate animal control programs.

In sum, the joint efforts of businesses, governments, academia and conservation groups to combat invasive alien species are necessary. Sustainable profit is not all that businesses gain from these conservation efforts. Business can enjoy a better working relationship with their partners as well as lasting environmental benefits.

Equally important is that some industries can improve their practices to reduce the risk of introducing and spreading invasive alien species via key pathways. Voluntary standards could be established for these industries, coupled with on-going educational programs for their employees and clients. For instance, The Missouri Botanical Garden and Royal Botanical Gardens, with participation from the horticultural industry and other professionals, hosted a workshop in 2001 to develop strategies to reduce new introductions. Participants from several fields including government, garden clubs, the horticultural industry, and botanical gardens, developed a set of Codes appropriate for each of their respective interest groups. These Voluntary Codes of Conduct are the focus of the Preventing Invasion through Horticulture project and can serve as a guide for action to control the spread of invasive plant species[5]. Similar standards could be developed in aquaculture and the pet/aquarium trade, transportation and tourism. Specific standards might include: using native species to replace invasive; cross-checking goods and transportation vehicles with correct methods and tools before their departure; or cleaning boots before hiking in a new area to eliminate unintentional hitching of seeds and pathogens. These standards will be cheaper than regulations such as Hawaii's, which require increasing expenses in controlling invasive alien species. Thus, businesses can save costs associated with greater taxation to fund these types of programs or even more serious quarantine processes.

If every enterprise improves its practices even slightly, the return on investment for healthy and sustainable businesses will be substantial. As the old adage goes, an ounce of prevention is worth a pound of cure. Healthy business prevention practices will protect the environment while also protecting industries.

I thank Stas Burgiel, Frank Lowenstein, Mark Fox, and Faith Campbell for sharing their successful experiences on better practices to prevent invasive alien species, and thank Xu Chengcheng, Julie Perng, Christine Tam and Steve Blake for reading an earlier draft of this article and for their many helpful suggestions.

I thank Stas Burgiel, Frank Lowenstein, Mark Fox, and Faith Campbell for sharing their successful experiences on better practices to prevent invasive alien species, and thank Xu Chengcheng, Julie Perng, Christine Tam and Steve Blake for reading an earlier draft of this article and for their many helpful suggestions.

1 www.gisqp.org
2 www.invasivespeciesinfo.gov
3 www.gisp.org
4 www.invasivespeciesinfo.gov
5 www.gisp.org

Photo courtesy of *Jan Armor*, www.flickr.com/janthephotoman

Developing a Pet Trade Toolkit

THE PET INDUSTRY JOINT ADVISORY COUNCIL AND THE GLOBAL INVASIVE SPECIES PROGRAMME ARE WORKING TOGETHER TO DEVELOP A TOOLKIT OF REGULATORY AND NON-REGULATORY MEASURES TO MINIMIZE THE INTRODUCTION OF ANIMALS, PLANTS, PATHOGENS AND HARMFUL PARASITES VIA THE "PET/AQUARIA TRADE PATHWAY"

by **Jamie K. Reaser, PhD** ● Dr. Jamie K. Reaser, PhD is Senior Adviser for Health and Environment, Stewardship Pet Industry Joint Advisory Council (PIJAC) based in Washington D.C.

Invasive species (harmful non-native organisms) are one of the major threats to native wildlife and habitats. The pet/aquaria trade has been identified as a substantial source of potentially invasive species; escaped or released pets and aquaria species can predate upon, compete with, or spread diseases and parasites to native wildlife. Aquaria dumping and water gardening can also be sources of invasive plants, pathogens, and parasites.

The greatest risks along this pathway are likely associated with:

- Consumers (pet owners)
- Non-regulated direct sales – through the Internet and newspapers, hobbyist shows, flea markets, etc
- Pets that are free or inexpensive
- Species which grow large, reproduce easily and in large numbers in captivity, have specialized dietary or other husbandry requirements and have aggressive temperaments
- Species ecologically suited to the geographic region in which they are maintained as pets.

The tools will be presented so as to be "scalable" to different socio-political, economic, and cultural contexts

In order to minimize the invasion risk of the "pet/aquaria trade pathway," Parties to the Convention on Biological Diversity (CBD) adopted a decision (May 2008) to collate case studies of best management practices that industries, governments, and others are taking to prevent the release, escape, and establishment of former pets and aquaria species. The CBD explicitly recognized the Pet Industry Joint Advisory Council (PIJAC; www.pijac.org) and the Global Invasive Species Programme (GISP; www.gisp.org) as leaders in this process. Thus the two organizations are now working together to develop a toolkit of regulatory and non-regulatory measures to minimize the introduction of animals, plants, pathogens, and harmful parasites via the "pet/aquaria trade pathway."

The final product will be co-authored by Dr. Jamie K. Reaser (PIJAC Senior Advisor for Health and Environmental Stewardship; former GISP Executive Director) and Ms. Clare Shine (Independent Legal Consultant and co-author GISP books on invasive species/legal frameworks). It will be modeled after the comprehensive GISP Toolkit (Invasive Alien Species: A Toolkit for Best Prevention and Management Practices; www.gisp.org) and made available in multiple formats: executive summary (PDF and print) and as a complete publication (PDF and print-on-demand).

The final version of the Toolkit will be released at the 10th Conference of the Parties to the CBD, October 18-29, 2010 in Nagoya, Japan. As opportunities permit it will also be available online and through other international fora (e.g., the Ramsar Convention on Wetlands and the International Plant Protection Convention (IPPC)).

Financial support for the project is currently being provided/pledged by the UK Department for Environment, Food, and Rural Affairs (DEFRA); US Fish and Wildlife Service (USFWS); PIJAC US; PIJAC Canada; the American Pet Product Manufacture's Association (APPMA); and the Ornamental Aquatic Trade Association (OATA, UK).

Additional funding, particularly from CBD Parties and the pet/aquaria industry outside of the US is being sought. Case studies of relevant regulatory and non-regulatory measures are welcomed from around the world. Note: Case studies that have been submitted to the CBD Secretariat are not necessarily made available for this project. Please submit your case studies directly to Dr. Jamie K. Reaser at pijacscience@nelsoncable.com.

Following are some examples of the measures that will be featured in the "pet/aquaria trade pathway" toolkit. The tools will be presented so as to be "scalable" to different socio-political, economic, and cultural contexts.

ANIMAL INSPECTION, ACCLIMATION, AND QUARANTINE PROTOCOLS/PLANS

At various stages (e.g., import, distribution, retail) along the pet trade pathway animals are:

- Thoroughly inspected for external parasites, signs of disease, and "hitchhikers" (e.g., other animals or plants, soil, etc) in order to minimize the risk of biological invasion. [Note: housing and shipping containers are inspected as well]
- Acclimated to specific husbandry conditions in order to reduce stress factors which could make them more susceptible to pathogens and parasites.
- Quarantined to enable a) further inspection overtime and b) treatment of issues of concern.

BIOSECURITY MEASURES: HOUSING, PACKAGING, AND HANDLING

- Ensure that pets, as well as associated pathogens, parasites and hitchhikers, cannot escape from, or be transmitted through, industry facilities or during transport

CARE SHEETS

- Provide pet owners with information on the proper care of specific types of pets so that they can a) determine if that species is the best choice of a pet; and b) keep the pet healthy and adequately housed

CODES OF CONDUCT/PRACTICE

- Provide a list and description of actions that can be taken by the industry and/or consumers to minimize the risk of pets being abandoned or escaping. In some cases the codes also address aquatic plants and hitchhikers

CONSUMER EDUCATION/OUTREACH CAMPAIGNS

Use a comprehensive approach to:

- Raise awareness of the potential environmental, economic, and/or human health implications of pet abandonment (i.e. invasive alien species)
- Educate consumers on actions they can take to ensure a mutually beneficial relationship with their pets (i.e. proper choice of pet and care) so that the need/desire to give up the pet does not arise
- Educate consumers on actions they can take as alternatives to pet abandonment if they do need/desire to give up their pet.

CUSTOMER RECORD KEEPING

- To be able to contact the customer if there is a need to inform them of relevant information (e.g., disease risk)
- Obtain written customer acknowledgement (signature) on a form that outlines specific care needs, risks, etc. relating to the pet purchased.

INDUSTRY EDUCATION/OUTREACH CAMPAIGNS

- Raise awareness within the pet industry (e.g. importers, distributors, retailers) of invasive alien species issues
- Educate members of the pet industry on actions they can take to minimize the risk of biological invasion
- Empower members of the industry to educate consumers on invasive alien species issues and responsible behavior (e.g. pet choice, care and placement).

Photo courtesy of *H G Mukhopadhyay*, www.flickr.com/hgmphotos

REHOMING PROGRAMMES

- Find new responsible homes for unwanted pets.

SAME GENDER PROGRAMMES

- Eliminate unwanted matings which could lead to pet overpopulation.

SPAY/NEUTER PROGRAMMES

- Eliminate unwanted matings which could lead to pet overpopulation
- Enable owners to house animals of opposite sex together, which can reduce the risk of pet-pet aggression.

For more information on this project, please contact Dr. Reaser at pijacscience@nelsoncable.com; Tel: 1-434-990-9494. Address: 1220 19th Street, Suite 400 Washington, D.C. 20036

Species on the move – are 'Business Highways' watching?

INVASIVE ALIEN SPECIES POSE A GLOBAL THREAT AND NO CONTINENT IS FREE FROM THIS MENACE. THE LOSS IN AGRICULTURAL YIELD, FOREST PRODUCTIVITY AND LANDSCAPE QUALITY SHOULD LEAD TO PROACTIVE INTERVENTION FROM THE BUSINESS COMMUNITY WORLDWIDE.

by **K.V. Sankaran** and **T.V. Sajeev** ● K.V. Sankaran is the Director of the Kerala Forest Research Institute Dr. Sankaran is also Coordinator of the Asia Pacific Forest Invasive Species Network (APFISN) supported by the Food and Agriculture Organization of the United Nations (FAO) and the USDA Forest Service. He can be contacted at: *sankaran@kfri.org*. T.V. Sajeev is a Scientist (Forest Entomology) at the Kerala Forest Research Institute.

More than ever, globalised markets are facilitating the movement of species across continents. Most of these are unintentional. Aided by bulk transfer of commodities and weak quarantine checks, species which enter a new country create havoc on the native landscape. This occurs through the competitive exclusion of local species, thus smothering local vegetation, monopolizing resources, flooding habitats with their sheer number, causing diseases, for which local remedies do not exist, and by seriously denuding the local biodiversity. The economic and ecological damage caused by these invasive species is not well known, except in academic circles.

In our home state of Kerala in peninsular India, the ten-day long harvest festival of *Onam* starts when kids pluck the tender shoots with flowers of the native *Thumba* (*Leucas aspera*) and *Thulasi* (*Ocimum tenuiflorum*) and place them in a floral carpet in the courtyard. As kids, we had the first feel of the local biodiversity when we were told that only these species could be used on the first day. Over the next few days, the circle gets filled with flowers of various species added on as concentric circles until the tenth day when we await the visit of King Mahabali, the legendary ruler of yesteryears. Children today don't have the privilege of running around with baskets collecting an assortment of flowers, and if ever they do would run into invasive species which have grown over everything sacred. Now that the local shrubs and herbs have receded, we see the fierce battle between the early and late invasive species brought in through successive waves of invasion, wherever the canopy is open.

Economic impact of invasive species estimated at US $ 1.4 trillion globally, i.e., 5% of global GDP

How does this happen? What are the pathways in which invasive species gain entry to a new landscape? How do we deal with them? And, more importantly, what do business hubs have to do with these species on the move? It is high time that we develop intervention protocols to break the travel of alien species into newer areas.

THE START

Invasive species are those plants, animals and microbes non-native to a specific ecosystem whose introduction will cause economic and ecological harm and/or harm to human health. From the land of origin the start of the journey to new locales can be due to intentional transport by humans for agricultural, forestry, ornamental or dietary needs, as in the case of *Lantana camera* (as an addition to botanical gardens in India), the Asian oyster (in an effort to augment depleting native species in fisheries), the torpedo grass (as cattle forage grass) or the Australian pine (as a wind break to border agricultural groves). It can happen as an accidental escape from captive cultivation, as in the case of the Walking fish, the Blackchin tilapia, and the aquatic plant Hydrilla in Florida. However, most of the takeoffs are accidental along with commercial agriculture shipments, transport of timber/other wood products, during ship hull fouling or in ship ballast as in the case of wharf roaches, barnacles and mussels. These unintentional takeoffs can happen by air too, through passenger and cargo airlines. The first step to be taken by the international business community towards arresting biological invasion is to prevent this take off of unwanted organisms by adhering to the quarantine procedures in its entirety.

ON THE MOVE

The second phase of the journey is the travel proper in which the organism can be in the form of seed, fruit, spore, plant part, egg or the complete organism. Many organisms can successfully negotiate this traveling period by way of being dormant or by being in forms of propagules. Some species also undergo natural range extension as in the case of migratory cattle egret, a native of Africa which successfully established in Florida owing to widespread landscape conversion to pasturelands. International hitch-hiking of prospective invasive species through trade and travel (ships, airplanes, shipping containers, packing materials, unprocessed logs etc) has been on the rise in recent years. Offshore checking of the vessels and goods is one method to curtail the traffic of invasive species.

ARRIVAL

Sea and air ports are the most important sites of landing for invasive species. Most species can be detected at ports if stringent quarantine measures are in place. Regular port surveys are an essential part of Early Detection and Rapid Response system (EDRR) which can attend to any species which have escaped the quarantine process. The EDRR can be further strengthened by making available early alert systems banking on species tracking information collated from countries across the globe.

ESTABLISHMENT

Not all species which arrive in a new place become successfully established. Establishment is a tricky process. Many factors like physiological tolerance, ability to act as pioneering species, small seed mass, short juvenile period, prolific seed production and rampant vegetative propagation play decisive roles. Locally, the absence of parasites and predators will be of high benefit for the species to establish. In the later phases of establishment qualities like shorter generation time, phenotypic plasticity, fire tolerance and efficient dispersal of propagules would give critical edge for the invasive over the local species.

SPREAD

Once established, a truly irreversible process starts in which the invasive species expands its range. In this phase, the invasive exhibits better competitive resource capture and utilization abilities than the native plants. In China it was noted that Eupatorium – an invasive – allocated more nitrogen to the photosynthetic apparatus than three native species leading to higher CO^2 assimilation rate, carboxylation efficiency and apparent quantum yield. The invasive would produce and release allelopathic chemicals which would hinder the growth of native species wherever it establishes. In a cascade of ecological manipulations, it alters ecosystem processes, hydrology, primary productivity, decomposition, nutrient cycling, fire regimes, damage through broadcast of pesticides and herbicides, affects closely related indigenous species by hybridization, changes soil structure and profile and induces allergic responses. This impact extends to forests, agricultural land, plantations, grasslands, arid lands, oceans, lakes, streams, water quality, fisheries, animal husbandry, roads, waterways, recreational sites and wildlife populations.

The economic impact of this spread of invasive species is estimated at US$ 1.4 trillion globally, i.e., 5% of the global GDP. It costs US$ 15 billion to China, US$ 136 billion to the United States and approximately US$ 200 billion annually to the Asia-Pacific region. The statistics for the Asia-Pacific region are apparently a gross under-estimation.

The rate of spread of invasive plants is generally in logarithmic proportions. Consider the case of *Acacia mearnsii* (black wattle) planted in around 500 h of natural grasslands in Munnar, Kerala, India in the 1980s. Known for its high quality tannin, the tree is also useful as fuel wood, charcoal, paper pulp, green manure, for erosion control, soil improvement, land reclamation, and as shelter belt. The plantations in Munnar failed due to high seedling mortality, eco-climatic stress and other factors. However, at one site, the trees started to invade the natural subtropical montane (shola) forests (which grow in close juxtaposition with the grasslands) at the rate of 1km2 in a few years suppressing the native flora which include rare and endangered species. And, it could disperse itself up to 23 km away, and also into the Eravikulam National Park which houses the endangered Nilgiri Tahr.

These invasions are evident with severe impact in human impacted landscapes and are deadly in small islands as compared to highly diverse, un-impacted mainland habitats. This is because small islands usually feature low species diversity, small populations, restricted genetic diversity, reduced competitive ability and narrow ranges. Invasive species have been directly implicated in at least 55% of historical bird extinctions on islands. Human impacted landscapes offer more ecotone area or habitat boundaries which can receive new species and opening up of the canopy due to disturbance brings in direct sunlight to which the invasives respond faster than the natives. In Mauritius, the introduced Javaneese deer, wild pigs, and rats have seriously damaged the native vegetation, while Chinese guava, privet and wild pepper are replacing them. In the Seychelles, *Cinnamomum verum* and *Paraserianthus falcataria* top the list as threats to native species.

BUSINESS HIGHWAYS

What is at stake is the diversity of life formed through eons of evolutionary processes. In the global climate change scenario the movement of invasive species is expected to be on the rise. There is a great homogenization drive happening in vegetation mosaics wherein diverse plants in a habitat are replaced by one or a few species of invasives. As studies on the invasive tree species have shown, no continent is free from this menace. The loss in agricultural yield, forest productivity and landscape quality should lead to proactive intervention from the business community, worldwide. Awareness of the threat of the invasive should be internalized by the airline and shipping companies and the tourism sector so as to implement controlled sanctions on suspected invasive transport. One of the key ways to resist invasive species is to have undisturbed, vegetated landscapes holding high diversity of local species. Inland businesses should be able to respond to this requirement. Afforestation programmess which aim at carbon credits can be tailored to reap the multiple benefit of resisting the invasives.

Photo courtesy of *Jan Armor*, www.flickr.com/janthephotoman

We don't think the floral carpets, so diverse and colourful, would ever return into our festivities. But there are still pristine habitats, productive agricultural systems, and un-denuded forests which are at risk of being invaded by invasive species. The threat is global which requires the business community to step in to increase awareness on invasive species, not pick them up, watch out for them in transit and landing, and to make use of afforestation programmes for ecological restoration of invasive infested sites and to resist invasion.

Increasing Number of Invasives Threaten European Flora, Fauna and Habitats

GLOBALISATION AND AN INCREASE IN INTERNATIONAL TRADE AND TRANSPORT OF PEOPLE AND GOODS THROUGH TOURISM AND INTERNATIONAL TRAVEL ARE JUST SOME OF THE WAYS ALIEN SPECIES ARE SPREADING THROUGHOUT EUROPE.

by **Eladio Fernández-Galiano** ● Mr. Eladio Fernández-Galiano is Head of the Biological Diversity Unit, Council of Europe, *www.coe.int/biodiversity*, based in Strasbourg, France. He can be contacted at *eladio.fernandez-galiano@coe.int*.

Europe is a continent with a long history of international travel and biological exploration of other lands. Often hoping to be able to "acclimatise" or grow many useful or interesting species, travellers, explorers, scientists, tradesmen, and amateur botanists and zoologists brought back to Europe an innumerable number of biological materials. As a result, Europe harbours a very high number of non-native species. Some of these have become invasive and threaten native ecosystems or species. This is the main reason why Article 11 of the 1979 Convention on European Wildlife and Natural Habitat (better known as "The Bern Convention") requires Contracting Parties "*to strictly control the introduction of non native species*". Forty-five of the 49 states in Europe have signed the Convention, which is run by the Council of Europe.

Another European legal instrument, the European Union (EU) Habitats Directive (Directive 92/ 43/ EC) – applying to the 27 members states of the Union – contains similar provisions restricting the introduction of alien species. Article 22 of the Directive requires deliberate introduction of alien species into the wild to be regulated to avoid prejudice to native flora and fauna and, if necessary, to be prohibited.

The number of new alien species arriving in Europe is increasing dramatically – in the last 56 years, for example, an average of 24 new species of plants have become naturalised annually in Europe

NEW THREATS - TRADE AND TOURISM

As many species are introduced accidentally trough trade and tourism, legal prohibition of imports of alien species or their deliberate release in nature need not be the only mechanisms used in Europe for the prevention new arrivals. Globalisation and an increase in international trade and transport of people and goods through tourism and international travel provide excellent opportunities for alien species to be moved through a variety of pathways (in soil transported with horticultural species, in ballast waters, in packaging, as seeds introduced as "contaminants" in otherwise innocuous grain or bird feed, in shipped containers, etc.).

Too often, European tourists bring exotic pets that risk ending up in natural or semi-natural habitats. As a result the number of new alien species arriving in Europe is increasing dramatically, as was shown in a 2007 European Union project, called DAISIE (Delivering Alien Invasive Species in Europe) which provides precise data on trends and numbers of alien species introduced in Europe. For example, in the last 56 years, an average of 24 new species of plants have become naturalised annually in Europe. The report created an inventory of invasive alien species in Europe, with particular reference to invasive species that threaten terrestrial, freshwater and marine environments.

POLICY RESPONSE

Alarmed by the lack of implementation of the provision on introduction of alien species (and also by the detrimental effect of some misguided re-introductions on native biodiversity), the 45 European States cooperating in the framework of the Bern Convention decided in 1992 to create a specialised group of experts on invasive alien species to provide guidance to States. In 2003, the Convention adopted a European Strategy on Invasive Alien Species (Genovesi and Shine, 2003). This followed on the heels of the adoption by the 6th Conference of the Parties of the Convention on Biological Diversity (decision V1/23 of April 2002) of its "Guiding Principles for the prevention, introduction and mitigation of impacts of alien species that threaten ecosystems, habitats or species". The Strategy followed these "guiding principles" but went further than the recommended action. It promoted the development and implementation of co-ordinated measures and co-operative efforts throughout Europe to prevent and minimise adverse impacts of invasive alien species on Europe's biodiversity, as well as their consequences for the economy and human health and well-being.

The Strategy also provided guidance to the Bern Convention Parties. This included:

- raising awareness and information on IAS issues
- strengthening national and regional capacities to deal with IAS issues
- preventing introduction of new IAS and support rapid remedial responses
- reducing adverse impacts of IAS
- recovering species and natural habitats affected
- identifying priorities and key actions.

When the Strategy was adopted, governments were asked to draw up and implement national strategies on IAS.

The European Union, worried by the extent of the problem, approved a specific policy document called Biodiversity Communication (COM(2006)216) which recognised that, although EU support had been given to many EU and national programmes to prevent new arrivals and spread of new invasive species and to eradicate or control some particularly dangerous species, "the Community has still to develop a comprehensive strategy to address the issue". The Commission states that "various measures for the prevention and control of invasive alien species are in place but some policy gaps remain; a comprehensive EU strategy should be developed for this purpose as well as specific actions including early warning systems". To further that work the Commission created a working group on IAS that started work in March 2009.

CAN TRADE BECOME LESS IAS FRIENDLY?

One particular problem that has so far made new regulation on trade and IAS difficult is that the new regulation needs to take into account the free trade policies defined in the European Community treaty and World Trade Organisation rules. There is great reluctance by governments and the EU to deliver regulations that may limit the free trade policy, which makes IAS prevention very difficult. Movement of species between different bio-geographical regions of the continent is also a source of the spread of IAS.

Some states have opted to pass laws listing species that are to be excluded from trade (so-called "black lists"). The European Strategy on Invasive Alien Species (not a mandatory document) calls for the establishment of policies in which alien species proposed for introduction in one state have to be assessed through a comprehensive screening system based on risk analysis. Such a system already exists for phytosanitary reasons, developed by the European and Mediterranean Plant Protection Organisation, which has identified a few species to be excluded from trade. The Bern Convention adopted in 2007 a metalist of species to be excluded from trade, but again such a list is not mandatory. Similar efforts have been made by the European Environment Agency, which also developed a system of "early warning", by a network of Baltic cooperation on IAS (NOBANIS) and by the DAISIE project mentioned above. Although these initiatives are interesting and worthwhile, they are far from the strict regulation needed to control the problem.

CODES OF CONDUCT

As many governments are particularly reluctant to introduce new, more stringent regulation on IAS or opt for regulations difficult to implement (Italy, for instance, does prohibit the release in nature of the American Grey Squirrel, Sciurus carolinensis, but permits its trade and sale in pet shops) it becomes essential to develop other softer, more cooperative instruments against IAS, such as codes of conduct for businesses dealing with plants, animals or transport and trade of goods that create pathways for IAS.

Most alien plants introduced in Europe have been deliberately introduced for agriculture, forestry, gardening, horticulture, or use in aquaria. The many European botanic gardens and botanists also handle a high number of non-native plants in their scientific efforts to study the variety of plants on Earth. The horticultural industry brings into Europe a substantial mass of soil with the plants it imports, as well as many other seeds from non-target species. Species can easily escape cultivation and get established in the wild or in man-altered habitats. Very serious problems may arise in European aquatic ecosystems

when aquatic plants (such as the water hyacinth Eichhornia crassipes) escape aquaria. In Spain alone, this species spectacularly invaded 80 km of the Guadiana River in 2003. The cost of eliminating it was over €18 million.

In 2008 the Bern Convention adopted a "Code of Conduct on Horticulture and Invasive Alien Plants" (Heywood & Brunel, 2008). It is a voluntary instrument aimed at the horticultural industry and trade which promotes self-regulation. It requests people engaged in horticulture to help control IAS and to avoid new invasions by taking a number of precautions. Some States have drafted similar national codes and the Convention is now working on a new Code on Companion Animals and IAS.

Let us hope that all these efforts will bear fruit and IAS will become less of a problem for biological diversity in the next decades.

Photo courtesy of *Phil Warner*, www.flickr.com/rhithrogena22

SECTION II /

COMBATING INVASIVES IN JAPAN

Overview of invasive alien species in Japan and the measures taken to combat them

Tomatoes and the Bumble Bee

PLACING THE BOMBUS TERRESTRIS BUMBLE BEE ON THE INVASIVE ALIEN SPECIES ACT IN SEPTEMBER 2006 HAS FORCED FARMERS AND FOOD COMPANIES IN JAPAN TO TAKE ACTION

by **Kaori Fujita** ● Ms. Kaori Fujita is a senior writer for *Nikkei Ecology*, a monthly magazine focusing on environmental management and technology published by Nikkei Business Publications, Tokyo, Japan. She can be contacted via email at *kfujita@nikkeibp.co.jp*

Tomatoes account for 10% of vegetable production in Japan and are worth up to 200 billion-yen annually. This staple food has alerted farmers and producers to the issue of alien species as a result of the wide use of *Bombus terrestris* as a pollinator in the cultivation of tomatoes. However, since this bumble bee was placed under the Invasive Alien Species Act in September 2006, farmers and food companies have been forced to take action in order to preserve their reputation among consumers.

The bee, first introduced from the Netherlands into Japan in 1991, became very popular throughout the country for its laborsaving benefits in tomato cultivation. Today almost half of greenhouse tomato farming in the country relies on this species for pollination. It eventually became clear that if these bumblebees escaped from the greenhouses, they could drive out native bumblebees and wreck the plant ecosystem. Under the new regulation, permission must be obtained from the national authorities for importing and rearing bumblebees. In addition, farmers using the bumblebees are required to install screens in their greenhouses to prevent the bumblebees from escaping into the wild. Corporations releasing their bees into the wild are subject to a fine of up to one hundred million yen.

Tomatoes account for 10% of vegetable production in Japan and are worth up to 200 billion yen annually

Kagome, a leading Japanese food manufacturer, took action ahead of others even before the enactment of the new regulation. In May 2005, the company decided to stop using *Bombus terrestris* at the eight farms directly-managed by it throughout the country. It switched to the cultivation method using a native species *Bombus ignitus*. "On the basis of corporate ethics, we didn't want to take the risk of using an alien species which could adversely affect the ecosystems," says Satoshi Harada, Manager of the Fresh Vegetable Business Department at Kagome.

In those days, however, the cultivation method for using the native bumblebees, *Bombus ignitus*, had not yet been established. As the native bumblebees are known to be slow in movement, the use of them could have resulted in lower pollination efficiency and production quality. Kagome's determination, nevertheless, was firm. The company encouraged technological development of mass breeding of *Bombus ignitus*, developed production knowhow to increase pollination efficiency, and eventually established a cultivation method using the native bumblebees.

By pioneering the new cultivation method, Kagome, became a model for other companies to follow while at the same time, successfully established an eco-friendly tomato brand.

Aleph, a Hokkaido-based restaurant chain, is another company that addressed the *Bombus terrestris* issue at an early stage. At COP 9, Akio Shoji, President of Aleph declared the company's participation in the B&B Initiative (Business and Biodiversity Initiative) and set biodiversity conservation as its corporate mission.

"Bikkuri Donkey," the nationwide hamburger restaurant chain operated by Aleph, which serves hamburger plates with cherry tomatoes on top of the salad, in 2004, having heard of the *Bombus terrestris* issue from an ecologist, started handing out educational materials. This material illustrated the invasive alien species issue to its contract farmers and instructed them to take measures against the escape of the bumblebees. It has also distributed illustrated booklets explaining the issue at all its restaurants to educate the consumers.

In 2008, Aleph succeeded in persuading its contract farmers, who provide tomatoes to its company-owned restaurants (non-franchised), to give up using any kind of bees and shift to wind- or oscillation-based pollination.

Bombus terrestris can also damage the ecosystems and flora and fauna including the endangered species of native plants. Aleph employees are now engaged in weekend volunteer activities to help exterminate Bombus terrestris bees proliferating in the wild. Aleph's belief that promoting sustainable agriculture and protecting food culture are part and parcel of the work of restaurant operators has earned them the reputation among consumers as a green and eco-friendly company.

Measures against Invasion

EXAMINING SEVERE CASES, LEGAL REGULATION AND SUCCESSFUL CONTROL OF INVASIVE SPECIES IN JAPAN

by **Naozumi Sukigara** ● Mr. Naozumi Sukigara is with the Japan Wildlife Research Center, he can be contacted at: *nsukigara@jwrc.or.jp*

As in other parts of the globe, there are now many invasive alien species (IAS) in Japan. Although it is comparatively easy to block them at the coastline or at ports, once they are rampant, IAS invades a wide area of the native ecosystems. They affect not only native ecosystems or human health, but also industry, in particular agriculture. Furthermore, in some cases, the regulation on IAS affects businesses.

SEVERE CASES

One of the most severe cases is the Largemouth Bass (*Micropterus salmoides*, photo 1). This game fish, which originated in North America, was introduced into Japan in 1925. The predatory fish eats native fish and non-vertebrates to extinction and causes serious damage to the fresh water fauna throughout the Japanese archipelago.

The Green Anole (*Anolis caloliensis*) was introduced to Japan from North America.

There is a similar case in the Ogasawara Islands (oceanic islands, 1,000 km south of Tokyo). Green Anole (*Anolis calolinensis*, photo 2), an insectivorous lizard from North America, is abundant in this area and eats small to medium size diurnal insects. Because of the reptile, the insect fauna of Ogasawara has been irrecoverably damaged, including many endemic species. These predator species can easily increase in population due to the lack of natural predator in small oceanic islands like this.

Exotic plants also effect the native vegetation. The black locust (*Robinia pseudoacacia*, *Leguminosae*, photo 3) is often planted on roadside slopes in Japan. As this tree can grow on barren land using the nitrogen fixation, it easily invades the surrounding native vegetation.

Agriculture also suffers from IAS. Alien carnivores, such as the Raccoon (*Procion lotor*) from North America, and the Masked Palm Civet (*Paguma lalvata*) from Asia, affect fruit growing. Every year they cause severe damage to watermelon, grape and other fruits. A recent problem has been the Golden Mussel (*Limnoperna fortunei*, *Bivalvia*) from China. This species fixes itself on rocks, concrete walls or each other using “byssus” (fibrous substance). Sometimes pipes for irrigation or drinking water are clogged with these mussels.

JAPANESE LEGAL REGULATION ON IAS

The Japanese government enacted the Invasive Alien Species Act in April 2005, in order to prevent and/or minimize the effect of IAS on the native ecosystems. Before this bill, there had been several regulations on introducing exotic species to prevent damage to human health and agriculture. This time, the government underlined the ecosystem because it recognized increasing threats and damage from IAS and took into account warnings from scientists.

Under the IAS Act, without the minister’s permission, breeding and raising, planting, storing and carrying the listed IAS are banned. Importing, transferring and releasing IAS without permission is also banned. There are 101 taxa on the list so far – from vascular plants to mammals. Domesticated species such as cats and goats are not on the list. Violators could face a prison term up to three years and/or a fine of three million Yen ($30,000). This bill also provides the legal basis for the control of IAS, including eradication. The full text of the act and the list of IAS can be found on the website of the Ministry of the Environment, Japan (*www.env.go.jp/en/nature/as.html*).

THE ALIEN BUMBLEBEE

After the bill was in force, the control of the Large Earth Bumblebee (*Bombus terretris, Hymenoptera*, photo 4) successfully proceeded. In this case, scientists, farmers, material makers for agriculture and public sectors collaborated with each other.

The bumblebee was introduced into Japan in the early 1990s from Europe. Farmers have used this insect as a pollinator mainly for tomato growing in green houses. Because of its importance for tomato farmers, approximately 70,000 colonies were distributed annually. The first reason for this was to reduce the work force required to pollinate tomatoes in green houses. In the past, farmers shook flowers to fructify tomatoes because the tomato has wind-pollinated flowers. This process took much time and manpower. Bumblebees can fly inside the green houses, pollinate tomatoes and make fruits without manpower. The second reason was to substitute the bee for hormones. Tomatoes can also be fructified by hormones, but the quality of these fruits is not good in comparison with hand pollinated ones. Using Bumblebees brought better quality of tomatoes. And that might be one of reasons that consumers tend to prefer "less sprayed" products, in Japan.

ASSESSING THE AFFECTS

Scientists warned about the potential affects this exotic Bumblebee would have on the native ecosystems. The naturalization was reported, the competition with native bee species on resources was predicted and the hybridization with native bees was emphasized. Later, the hybridization was confirmed in the field by DNA analysis and it was reported that the population of the native bee was in decline. These scientific assessments became the strong drivers to proceed with the control of the exotic Bumblebee.

COLLABORATION BETWEEN SECTORS

The scientific findings drove forward the process. The Farmers Association and Ministry of Agriculture, Forestry and Fishery agreed on regulations for the alien bee. Following a long series of discussions, measures were implemented.

> To combat IAS effectively all stakeholders must sit together and discuss the measures and their implementation

One of the main points is to have a net in place at the entrance of the green house, to prevent the Bumblebee from exiting (photo 5). For this purpose, the makers of agricultural material developed the nets to achieve the prevention. Now these nets are widely used.

The next step is to terminate the Bumblebee colony. When pollination is finished, the farmers should scrap the exotic bee colony. This is important because farmers should be in control of all alien bees.

Local governments provide needed information on the above. A manual is distributed on the websites of local governments as is an explanation of the bill. For the monitoring of the bee, a network of citizens has already been established. Led by prominent scientists, the bumblebee network is observing the situation. Municipalities and others sectors are also involved, as is the Minister of the Environment.

THE WAY FORWARD

To combat IAS effectively, all stakeholders have to sit together and discuss measures and their implementation. Cost-sharing is also an important factor. To achieve the spontaneous participation of all bodies, it is necessary to promote public awareness for Biodiversity. One of the CBD's big goals, "the mainstreaming of Biodiversity" is also crucial to the issue of IAS.

ACKNOWLEDGMENTS

The Author acknowledges his colleague, Dr. Kano Koide and Dr. Toshio Kishimoto for their kind assistance and thanks the SCBD, for providing this opportunity.

Characterized by their white-ended abdomens, the Bumblebee (*Bombus Terrestris*) was introduced into Japan from Europe.

The Black locust (*Robinia pseudoacacia, Leguminosae*) is native to North America.

Prospects of Invasive Alien Species in Japan

EMPOWERING THE CONSERVATION OF BIODIVERSITY

by **Hidenori Kusakari** ● Mr. Hidenori Kusakari is the Deputy Conservation Director of WWF Japan. He can be contacted at: *kusakari@wwf.or.jp*

In July 2004 the Japanese Government adopted the Invasive Alien Species Act in response to the Convention of Biological Diversity's *Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats, or Species* and requests from many ecologists. There are more than 2,000 established alien species in Japan, of which the act has designated 96 species as being "most" invasive alien species.

Prior to this designation, WWF Japan, the Nature Conservation Society of Japan and the Wild Bird Society of Japan jointly produced a list of the most invasive alien species and submitted it to the Ministry of Environment on 27 October 2004, which greatly affected the selection.

While New Zealand and Australia apply the so-called "clean" list approach, which bans introduction of any alien species, Japan uses the so-called "dirty" list approach, which lists troublesome species.

> Important to promote public awareness to gain wide public support for invasive species control

Currently the national government, local governments, NGOs and NPOs implement pest control programmes against mongoose, raccoons, wild goats, large-mouth bass, etc. but the programmes do not cover all 96 species.

The Ministry of Environment budgeted 380 million Yen for the control of most invasive alien species. Serious adverse impacts on endemic species by alien species are recognized in the Amami Oshima Islands which is located 300 km south of the southern tip of Kyushu Island. Local experts working on mongoose control estimate that 2,500 million Yen is needed in Amami Oshima alone.

The pest controllers continue their steady and dedicated work. However, despite this, the problem of the pest control programmes is that the more successful they are in decreasing the pests, the more likely it is for the administration to reduce their budgets.

Technical innovation, supported by scientific basis, is key for more effective pest control. With the support of various corporations, more and more effective traps, pest control fences, and attractants are now available.

Nippon Keidanren, a nationwide business association, comprised of large Japanese corporations, which resolves problems of the business community through committees and makes proposals to government officials, made a declaration on biological diversity. One of the clauses of the guidelines in the declaration calls for businesses, "To voluntarily and steadily engage in activities contributing to biological diversity" and "Not only reduce effects of business activities on biological diversity but actively engage in activities bringing substantial effects on the conservation of biological diversity and contributing to society." The guidelines also call for businesses "To make every effort for the implementation of such activities, to take account of endangered species, rare species and invasive alien species." Presently Keidanren is asking its members to follow the guideline.

It is also important to promote public awareness to gain wide public support for invasive species control. WWF Japan produced "Mr. Pinch", a playing card type educational material which enables a wide range of people from elementary school pupils to adults to learn impacts of alien species on endemic species. Mr. Pinch is also effective in organizing eco-tourism activities in areas where endemic species recover from successful pest control programmes.

In June 2008 the Basic Law for Biological Diversity was enacted with pressure from public organizations including WWF Japan.

SECTION III /

INVASIVES IN INDUSTRY

Examining the role of the aquarium industry in the spread of invasives, the costs and responsibilities, and how one community has turned a problematic invasive into a profit.

Photo courtesy of *Daniel Larsson*, www.defblog.se

Invasive Alien Species and the Aquarium Industry

According to UN Food and Agriculture Organization (FAO) statistics the total value of the exports of ornamental fish in 2006 was about US$ 277 million. Although no direct statistical information about the total number of specimens are available, one could argue that considering the average price per fish per shipment the total number of specimens exported is well over 1.5 billion fish. No information is available about ornamental plants and invertebrates, but these are also exported in subtantial quantities.

THE AQUARIUM INDUSTRY MIGHT BE RESPONSIBLE FOR INTERNATIONAL TRANSPORT OF THE LARGEST NUMBERS OF ANIMAL, PLANT AND THEIR PATHOGEN SPECIES AND SPECIMENS ACROSS THE GLOBE

by **Dr. Alex Ploeg** ● Dr. Alex Ploeg is Secretary General of Ornamental Fish International (OFI). He can be contacted at *secretariat@ofish.org*

In general, the animals and plants produced or collected for keeping in aquariums or ponds originate from tropical countries in Asia, Africa and South America and are destined for mainly the USA, Europe and Japan. Differences in tastes of aquarium keepers and the wish for variety have led not only to a large number of species in the trade, but also to many captive bred varieties in color and body shape. When we think of large mammals like horses and polar bears, everyone realizes they have totally different needs. Horses have become feral in many places around the world but can one imagine a wild population of polar bears anywhere but the Arctic? Horses are adaptable whereas polar bears are not. Some fish are adaptable whereas the great majority of fish are tied to very stringent environmental parameters. The great majority of people do not realize that ornamental fish, plants and invertebrates, numbering well over 3000 species and varieties, have their own specific characteristics and needs.

AQUARIUM SPECIES AS IAS?

With the huge number of species and specimens involved it is quite logical that many are concerned about the role the aquarium industry plays in the introduction of potentially invasive species. The risks involved for a species to become invasive, however, depend on the specific characteristics of the species involved, the probability of escape and the climatological characteristics of the country involved. The species imported for an aquarium or pond can only turn into an invasive alien species if, through a chain of events, a sufficient number of species turn up in the wild to form a reproductive population, for which a minimum propagule pressure is needed. Furthermore, to become an IAS according to the CBD definition, it must establish itself, spread and cause harm to the biodiversity.

ESCAPES

In consumer countries with a temperate or sub-tropical climate, animals and plants are generally kept in closed environments such as aquariums or garden ponds. Marine organisms that escape into the wild are frequently not reported. They are kept in aquaria only and just a very few are kept in surroundings where it could be possible to reach marine conditions directly after escaping.

Freshwater ornamental fish are kept in closed environments of aquaria and ponds. Escapes from aquariums are unlikely as these are located indoors and open water is nowhere around. Floods are not a natural phenomenon in most of the consumer countries and even in case of flooding it seems unlikely that propagule pressures of the species will be reached. In ponds one often finds larger quantities, with fewer varieties of species. Ornamental fish and plants do carry pathogens. For several of the worst, as listed by the World Organisation for Animal Health (OIE), national and international legislation is already in place.

Most ornamental species that have turned into IAS can be found in countries where ornamental fish are farmed for export or for the internal market

Most ornamental species that have turned into IAS, however, can be found in countries where ornamental fish are farmed for export or for the internal market. Still some older farms may discharge water from the breeding basins directly into sewage systems or canals. In areas, close to these farms, we may find wild populations of guppies, swordtails, sucker catfish and several other species. In the neighborhood of some aquarium plant producers, especially the ones that have been operating for several decades, we may find populations of a few species of pond plants, even in countries with temperate climates. In the last decade, awareness about this issue has grown and is still growing. In new farms the escape risks are taken seriously.

RELEASES

Alien plants and animals are at times intentionally released into nature. Sometimes this is due to ignorance, while other people believe that they are actually doing a good thing. Hobbyists have a problem killing unhealthy or unwanted fish and often think that they are doing the fish a favour by releasing them into the wild. After cleaning a pond that has been overgrown with plants, the pile of plants left over has to be discharged somewhere. It will require a change in mindset to adjust this attitude. Hobbyists must become aware that releasing or dumping in the wild is not the proper action.

In some cases fish are released on religious grounds. Fish are purchased with the aim to set them free and gain merit. In countries where the local fish fauna is heavily protected, the only option is to purchase fish which are not local. If in these countries local fish would be available and allowed to be released for this purpose a large part of the problem would

be solved. Unfortunately governments prefer to introduce measures to prohibit imports of many fish species and very expensive control measures, instead of seeking an easy adjustment in their legislation for protection of local species which in many cases are not endangered.

And then there are of course always people who just want to release certain animals and plants in their garden or nearby nature to enjoy the species of a far away habitat in their own area. As a biologist I realize that many of my colleagues are among these people with this attitude.

In the past, species used for ornamental purposes have sometimes been released for (sport-) fishery purposes by governmental agencies or used in aquaculture by other governmental agencies. Some of these species are still released with these aims in mind. The 100 worst invasive alien species as listed by the IUCN Invasive Alien Species Group (ISSG) contains eight fish species, seven of which were released for fishery. The eighth species was also released by governmental institutions to fight mosquitoes. For the same reason guppies are still released in many countries.

Two of these species of invasive fish, carp and tilapia, are present in the ornamental fish trade. Both of these, however, are even more important in aquaculture and are used in many countries as valued food fish. Carp is also released in open water for sports fishing purposes.

CHARACTERISTICS OF THE HOST COUNTRY

Of course releasing a number of specimens of a certain species is not enough to create viable populations. The climatological circumstances and habitat characteristics play a very important role: the animals, plants or pathogens must be able to live in the new habitat.

The large majority of the aquarium animals and plants are tropical in origin and need constant temperatures above 12-15°C. These species will by definition not survive the winters in countries with a temperate climate. With species imported for garden ponds this will be somewhat different as these are usually well-adapted to temperatures in the country of import. The protection against distribution is the closed environment of a pond and the care of the owner and, of course, the characteristics of the species. Opportunistic, resilient species with a rapid reproduction rate have the best chances. Many pond fish, however, do not fall into this category. Colored fish are an easy target for predators, especially when they are still small. Species with complex reproduction strategies such as grass carp will never get established as habitats are (almost) never suitable.

In subtropical climates the risks are higher as many of the tropical fish may very well survive the winter. As long as the fish are kept in aquariums, the risks for escape are still very limited. Released animals, however, may stand a better chance of survival. When tropical fish are kept in garden ponds, the situation may differ, but again, only for resilient, opportunistic species. Many aquarium species are quite sensitive and not resilient at all, while others are very resilient. For example, some species of cichlids and snakeheads. Hobbyists, who under subtropical circumstances, release surplus species from ponds into open waters increase the risks of IAS introduction. An awareness raising campaign is necessary to educate aquarium hobbyists in these countries to avoid damage by released species.

As already indicated, the highest risk lies in tropical countries where resilient and opportunistic species can often easily adapt to their new circumstances. Unfortunately, especially around ornamental fish farms, some of the fish produced prove to be resilient. The Singapore water reservoirs now even contain South American stingrays. A few of them also spread and cause harm to the biodiversity. In other countries waters are infected with sucker mouth catfish which undoubtedly have been introduced for the aquarium industry.

INDUSTRY INITIATIVES

The aquarium industry is a rather well organized industry, compared to others, with national trade associations in many countries. Hobbyists also belong to associations which keep in close contact with each other; this in turn offers very good opportunities for cost-effective awareness-raising campaigns.

Several industry associations have already demonstrated their concerns and taken initiatives. For many years the Ornamental Aquatic Trade Association (OATA) in the United Kingdom, and the Pet Industry Joint Advisory Council (PIJAC) in the USA, have brought the message across in their countries through brochures, publications, messages on plastic fish bags and in agreements with governments.

Ornamental Fish International (OFI) is aware of its responsibility. In May 2009 it will publish a book on biosecurity in the aquarium industry in order to educate the industry to reduce the risk of introduction of pathogens. OFI will also organize a conference on Invasive Alien Species during the major trade show in the aquarium industry, Aquarama, in Singapore. This event will take place on 30 May 2009. The one-day conference aims at creating awareness in the aquarium industry and features speakers from governments, the industry and the CBD. Topics to be discussed include the introduction of the issue of invasive alien species, the role and responsibilities of the aquarium industry, preventive measures and eventual legislation. For more information: *www.ofish.org/about/ofi-conference*.

Ornamental fish shipment at Schiphol Airport, Amsterdam, Netherlands

Industry and Bioinvasion: Costs and Responsibilities

THE COSTS OF BIOINVASION ARE HIGH AND THE RESPONSIBILITY TO PROTECT LOCAL ECOSYSTEMS FROM INTRUSION MUST BE SHARED AMONGST INDUSTRY, GOVERNMENT AND CONSUMERS

by **Peter Stoett** and **Leah Mohammed** ● Peter Stoett is an associate professor and chair, Department of Political Science, at Concordia University in Montreal, Canada. Leah Mohammed is a research assistant and is a student in the Master in Public Policy and Public Administration Program, Department of Political Science, Concordia University, Montreal, Canada.

Though embryonic international regimes exist, and trade agreements do allow some room for policy innovation, corporate responsibility will be a major factor in stemming the tide of invasive alien species (IAS). There are at least three prevalent dynamics at work here. Transportation industries, especially shipping, are often blamed for the unintentional introduction of non-native species. Agriculture, gardening, landscaping, fish collecting, and aquaculture are just a few industries which deliberately import non-native species, which may escape from controlled environments. And manufacturing industries often have to deal with the costs of IAS first-hand, as they can disrupt production processes. Of course there are other cases; for example, tourism can be both a source of introduction as well as a casualty of mass bioinvasion. But we will focus this brief essay on aquatic IAS, providing an example close to the home of the CBD Secretariat.

THE GREAT LAKES AND AQUATIC INVASIVES

It is estimated that the North American Great Lakes is now infested with about 160 to 180 aquatic IAS, most of them due to foreign discharges of ballast water from transoceanic ships. The Great Lakes Fishery Commission reported that control, assessment, and research for the dreaded parasitic sea lamprey cost $13.5 million in 2001. But the zebra mussel, a native of Eurasia, is by far the most costly invader affecting both manufacturers and tourism. It entered the Great Lakes via ballast water discharges. Zebra mussels clog up water systems, reducing water flow, navigation, boating activities, and power plant production. Estimated cumulative costs for removing this aquatic IAS range, depending on the type of clean-up method, the intensity of the infestation, and the type of facility; for industrial plants along the Great Lakes accumulative cost estimates are from US$3 to 5 billion.[1] Furthermore, as zebra mussels become lodged on the hull, motor, or any other part of boats or fishing gear, this reduces boating and recreational activities, decreasing tourism activities on the Great Lakes. Boat owners, fishing outfits, and recreationalists are left to absorb cleaning costs.

> Industries need to educate their employees and consumers about the harmful impact of IAS, making it clear that prevention can, in the long run, save jobs and money

THE FEDNAV GROUP AND BALLAST WATER MANAGEMENT

The majority of aquatic introductions are related to shipping practices. A ship's ability to take on and discharge ballast water is fundamental to its safe operation; it provides stability and trim, reduces ship rolling, minimizes hull stresses, and aids in manoeuvring. A ship takes in ballast water (and sediment) when it is empty and dumps it when taking on cargo. Thus, ballast uptake and discharge occurs mostly in port, but may also occur while the ship is in transit as a means of maintaining stability. As ballast water is taken from one location and discharged in another, any marine organisms in the ballast water that survive the voyage are introduced into the non-native environment where the ship discharges.

The potential dangers of ballast water discharge are recognized by the International Maritime Organization (IMO) and the World Health Organization (as ballast water can be a medium for spreading bacteria and disease). The IMO hosts the International Convention for the Control and Management of Ships' Ballast Water and Sediment, which basically advocates that "Parties must prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediment."[2] Although the Convention sets standards for acceptable numbers of organisms present in ballast water, it does not include any measures for addressing the problem of no ballast on board (NoBOB). Unfortunately, the Convention, adopted 13 February 2004, has yet to enter into force; ratification will require the signature of 30 countries with 35% of the worlds shipping tonnage.

Despite the slow response to combating aquatic IAS via ballast water discharges, some successes on the industry side are notable. In particular, the environmental policy of the Fednav Group, an international shipping company based in Montreal, states that "[r]egardless of whether required under local or national rules, Fednav is committed to effecting ballast water exchange at sea and salt water flushing of empty ballast tanks whenever operationally feasible and safe."[3] Both techniques significantly decrease the chances of introducing non-native species. Furthermore, a presentation by the Fednav Group[4] explains that with the negotiation of the IMO's Ballast Water Convention, the company realized that new technologies were necessary to deal with this issue. As such, Fednav explored several treatment options and technologies and assessed the ones available on the market, in cooperation with Transport Canada. This led to the development of OceanSaver – a filtration system that disinfects ballast water. Another positive development is the signing of a "Global Industry Alliance" between several United Nations agencies, including the IMO, and four major international shipping firms: APL, BP Shipping, Daewoo Shipbuilding and Marine Engineering, and Vela Marine International. The adoption of new ballast-free ships may be the best answer, though this will understandably take quite some time to implement.

The horticultural "PlantRight" program in California is another example of how industrial partnerships can spread important information before IAS, with our unwitting help, spread themselves across national and ecosystemic boundaries. These moves will not solve the problem of extant IAS, but are solid steps toward a commitment to increase prevention. Similarly, agricultural and other commodity-based firms, and those involved in the aquaculture industry (both commercial and ornamental), need to install strict policies about monitoring and reporting their exports and imports; it is unsafe to rely entirely on overburdened governments to do this, and consumers often lack the necessary information to make informed choices. Expertise at the Global Invasive Species Program (GISP) and elsewhere is readily available.

Photo courtesy of *Gene Wilburn*, www.flickr.com/cdnphoto

COSTS AND RESPONSIBILITIES

Curtailing bioinvasion is not going to be easy, or cheap, and this is especially troubling in the midst of economic recession. But there are several sound reasons why industries should take whatever measures they can to avoid worst-case scenarios. Increasing public awareness of the scope of the problem suggests there will be less ability in the future to view IAS as unfortunate externalities. Pre-emptive actions, such as the use of OceanSaver technology, are investments in the future of transportation industries. It is certainly good public relations to take an active stance, and to approach the problem with vigour as corporate citizens. There are also research and employment opportunities generated by a strict avoidance regime, and governments will be likely to work alongside industries committed to such work, so it is better to become involved sooner rather than later. IAS are now seen by many as a serious national security issue, and this should induce public funding to help industries deal with the preventive side of the problem. Industries need to educate their employees and consumers about the harmful impact of IAS, making it clear that prevention can, in the long run, save jobs and money.

1 Perrings *et al.* "The Economics of Biological Invasions." in Harold Mooney, Richard Mack, Jeffery McNeely, Laurie Neville, Peter Schei, and Jeffery Wage, *Invasive Alien Species:*
A New Synthesis (London: Island Press:, 2005) 16-35.
2 International Maritime Organization. (2004) International Convention for the Control and Management of Ships' Ballast Water and Sediments. Retrieved 13 March 2009 from *www.imo.org/conventions/mainframe.asp?topic_id=867* (Article 2 under General Obligations)
3 The Fednav Group. (2007) "Fednav Environmental Policy." Retrieved 13 March 2009, from *www.fednav.com/anglais/enviroballastwater_en.html.*
4 The Fednav Group. (2006) "Aquatic Invasive Species: Industry Perspectives." Retrieved 13 March 2009, from *www.greatlakes-seaway.com/en/pdf/Fednav_Oceansaver.pdf*

SECTION IV /

VISUAL DATA

- Economic impact of IAS
- Economic impact of IAS biodiversity across biomes
- Cumulative number of confirmed human cases of avian influenza A

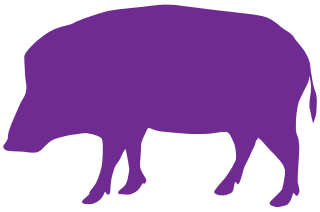
Photo courtesy of www.flickr.com/akaporn

Economic Impact of Invasive Alien Species

$ = approx. 20 million US dollars

$ $ $ $ $
$ $ $ $ $
$ $ $ $ $
$ $ $ $ $
$ $ $ $ $
$ $ $ $ $
$ $ $ $ $
$ $ $ $ $
$ $ $ $ $
$ $ $

US $800 MILLION



FERAL PIGS

(Sus scrofa)

US $800 million per year in losses and damages in the US (Pimentei et al. 2005)

$ $ $ $ $
$ $ $ $ $
$ $

US $300 MILLION

COFFEE BERRY BORER

(Hypothenemus hampei)

US $300 million per annum in India (GISP 2004b)

$ $ $ $ $

US $100 MILLION

WATER HYACINTH

(Eichhomia Crassipes)

US $100 million per year in losses and damages in the US (GISP 2004b)

$ $ $ $

US $80 MILLION

VEGETABLE LEAF MINER

(Linomyza sativae)

US $80 million per year for economic losses in China (Li and Xie 2002)

$ $

US $50 MILLION

SMALL INDIAN MONGOOSE

(Herpestes javarnicus)

US $50 million per year in Puerto Rico and the Hawaiian islands alone (GISP 2004b)

$

US $19 MILLION

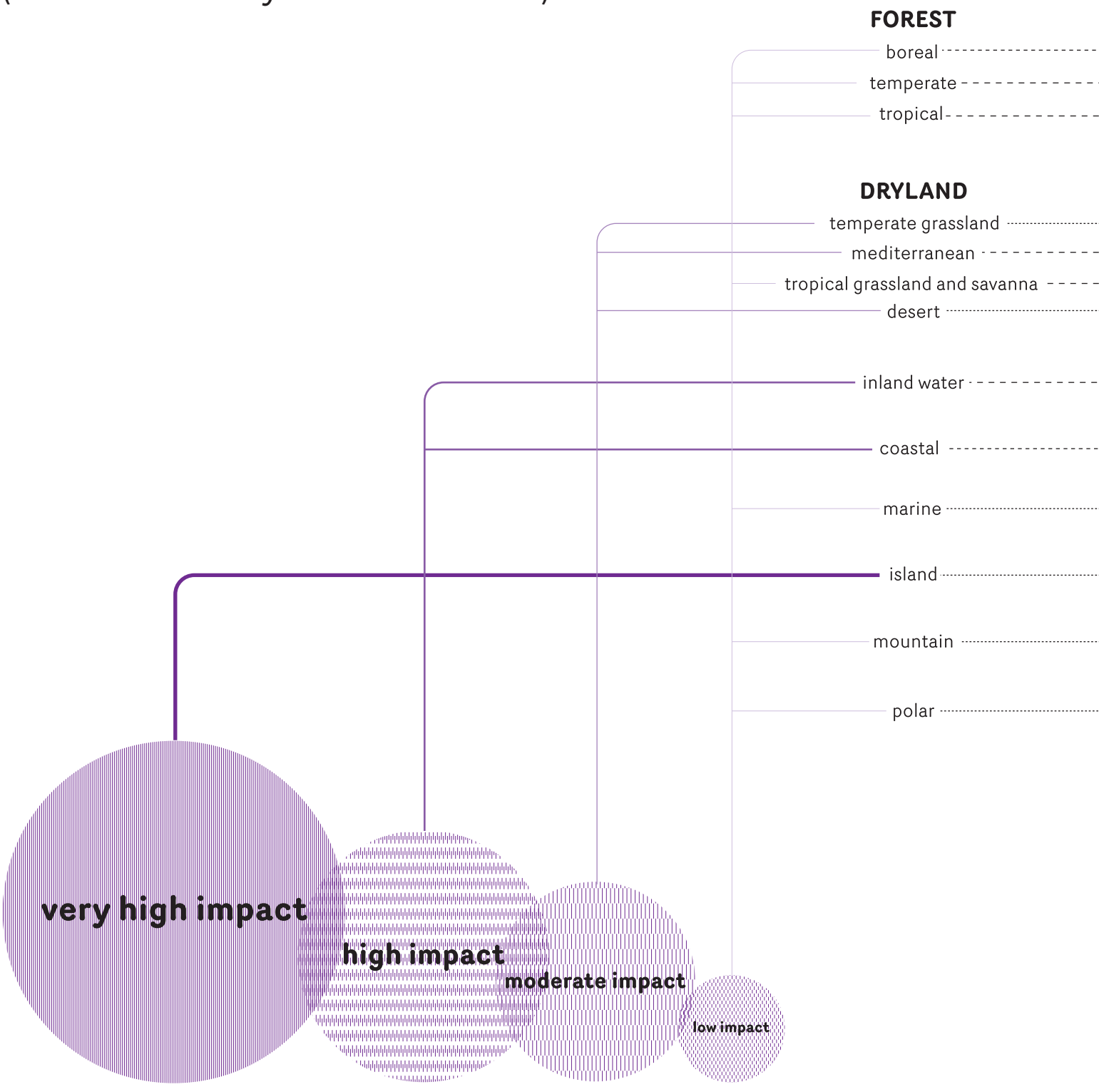
RATS

(Rattus rattus and R norvegious)

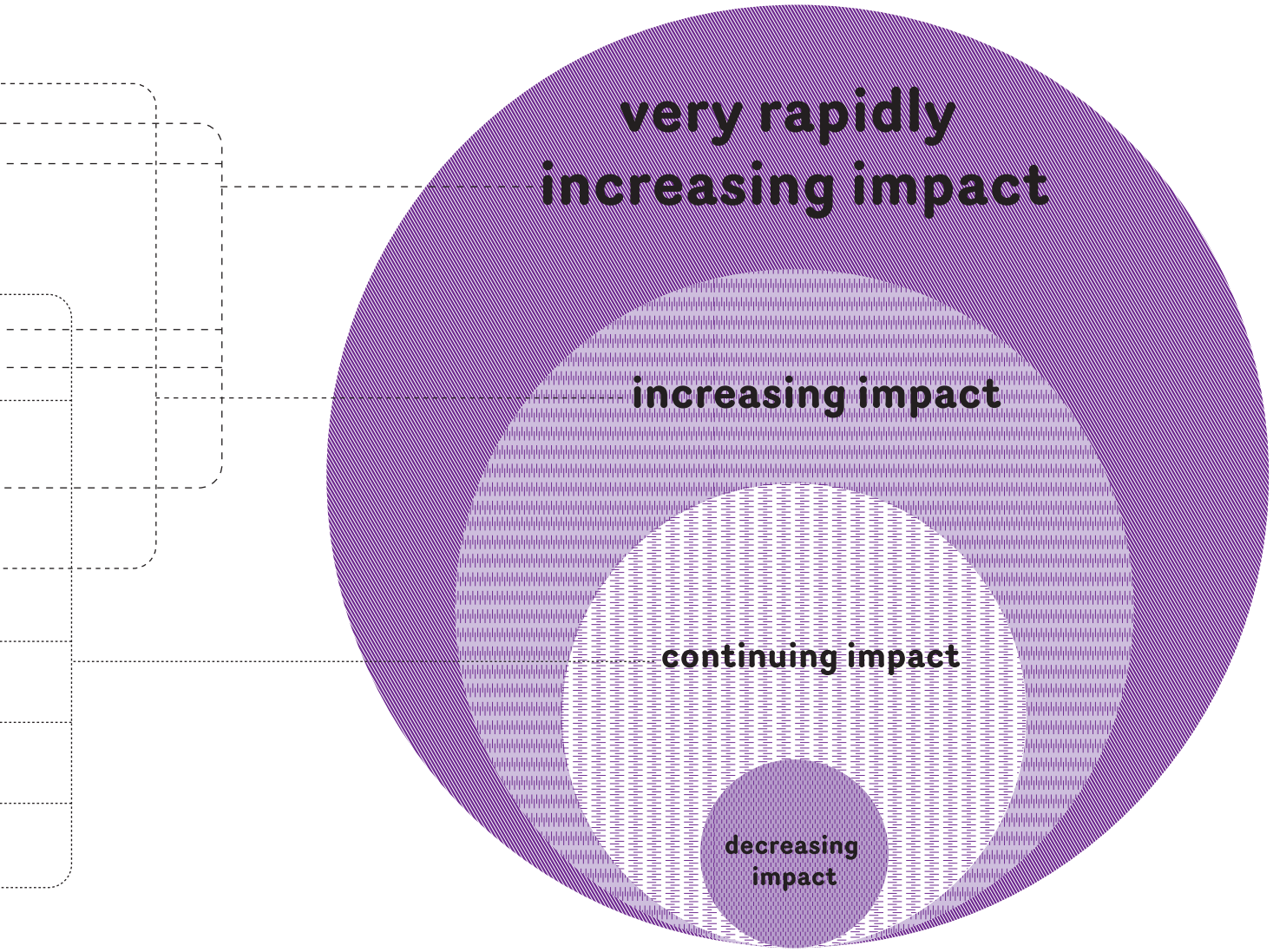
US $19 million per year in losses and damages in the US (Pimentei et al. 2005)

Economic impact of Invasive Alien Biodiversity across Biomes

(Millennium Ecosystem Assessment)



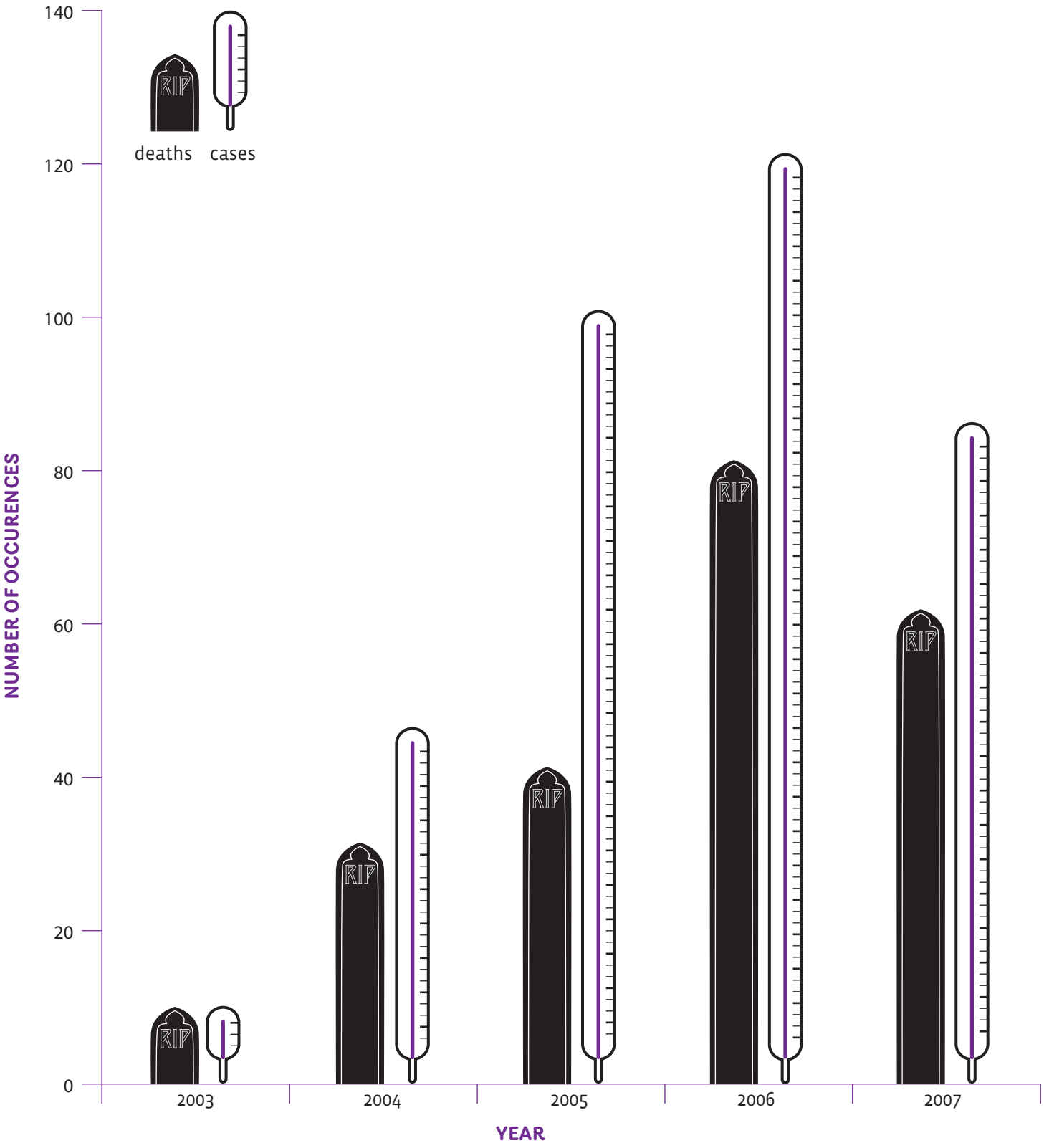
Species on



The 2 types of graphics indicate impact of invasive alien species on biodiversity in each type of ecosystem over the past 50–100 years according to 2 variables: level of impact to speed of impact increment .

High impact means that over the last century the particular driver has significantly altered biodiversity in that biome; low impact indicates that it has had little influence on biodiversity in the biome. The Figure presents global impacts and trends that may be different from those in specific regions.

Cumulative number of confirmed human cases of avian influenza A



International Day for Biological Diversity Events

The United Nations proclaimed 22 May the International Day for Biological Diversity (IDB) to increase understanding and awareness of biodiversity issues. The Day provides Parties to the Convention and those dealing with invasive alien species, an opportunity to raise awareness of the issues and increase practical action to tackle the problem. Here are a few examples of how countries marked this year's IDB:

CANADA

The city of Montreal marked the day at the Biosphere de Montreal, which included a joint statement on invasive species by the city of Montreal, the Government of Quebec, and the Government of Canada; and a presentation on the Biosphere exhibit on invasive alien species.

The sand wasp is an invasive species in Canada. Photo courtesy of *Gavatron*, http://www.flickr.com/gavatron.

JAPAN

The Japanese government held a symposium and an invasive alien species exhibit.

The pine nematode is an invasive species in Japan. Photo courtesy of *Ian Riley*, www.flickr.com/ian_riley.

GERMANY

The city of Frankfurt through its BioFrankfurt Initiative contributed to the celebration by engaging all stakeholders.

IRELAND

In Ireland, the Department of the Environment, Heritage & Local Government (National Parks and Wildlife Service) and environmental NGOs organized a series of nationwide activities during National BiodiversityWeek, from 17 to 24 May.

ETHIOPIA

In Ethiopia, the Institute of Biodiversity Conservation marked the day through a number of events. These included a one-day workshop and field visit to sites where invasive species pose a major threat to biodiversity, the distribution of brochures, booklets, posters, etc. to relevant institutions working on IAS, and raising awareness using the mass media such as national television, radio, and newspapers.

The African wild ass is an invasive species in Ethiopia. Photo courtesy of *redsea2006*, http://www.flickr.com/redsea_eilat.

BENIN

In Benin, a number of activities were held, including a workshop to assess the level of knowledge on invading alien species in Benin, a guided tour with the press of one of the sites colonized by invading alien species, and the design and distribution of posters to raise awareness about invading alien species and sustainable management of biodiversity in general.

The water hyacynthe is an invasive species in Benin. Photo courtesy of www.flickr.com/ravi_gogte.

PERU

Peru declared the week biodiversity week.

COLUMBIA

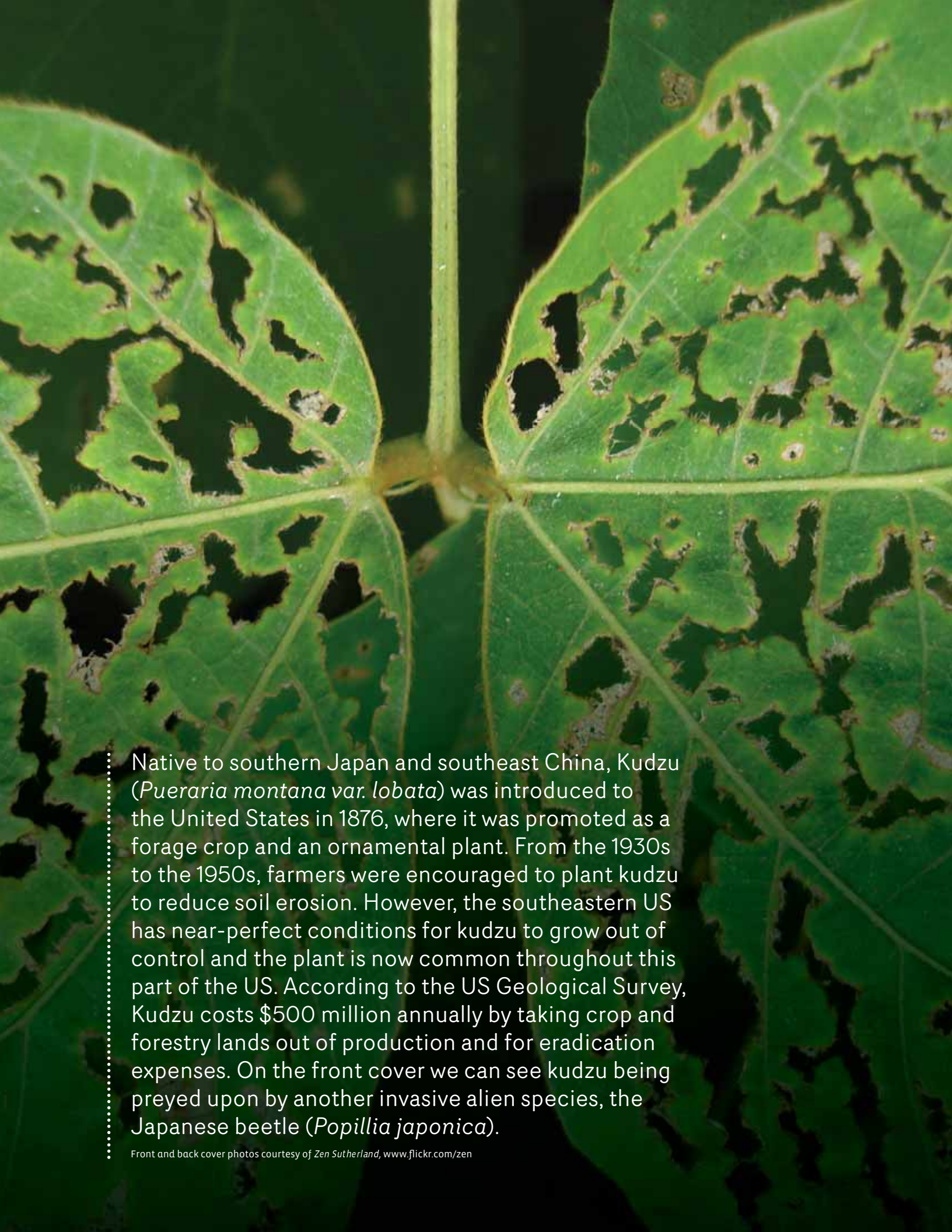
Colombia held a one day seminar to raise awareness on the issue of IAS, participants included government officials, NGOs, research institutes, private sector, academia.

FRANCE

In France, the National Museum in Paris held several events under the theme: « Les espèces exotiques envahissent le Jardin des Plantes » .

- 22 May – 5 June – a free exhibit including a presentation of examples on the introduction of IAS to raise awareness on the issue
- 23 May film debates within the framework « T'aime nature » , « La grenouille taureau » de Philippe Henry (2008, 37 min.) , « La guerre des écureuils » de Kamel Kézadri (52 mn), « Le dernier choux des Kerguelen » de François de Riberolles (30 mn)
- Débat avec Jean-Patrick LeDuc et Catherine Epain-Henry
- 24 May debates on IAS

The mosquito is an invasive species in France. Photo courtesy of *jciv*, www.flickr.com/jciv.



Native to southern Japan and southeast China, Kudzu (*Pueraria montana var. lobata*) was introduced to the United States in 1876, where it was promoted as a forage crop and an ornamental plant. From the 1930s to the 1950s, farmers were encouraged to plant kudzu to reduce soil erosion. However, the southeastern US has near-perfect conditions for kudzu to grow out of control and the plant is now common throughout this part of the US. According to the US Geological Survey, Kudzu costs $500 million annually by taking crop and forestry lands out of production and for eradication expenses. On the front cover we can see kudzu being preyed upon by another invasive alien species, the Japanese beetle (*Popillia japonica*).

Front and back cover photos courtesy of *Zen Sutherland*, www.flickr.com/zen