MANAGING THE GLOBAL RISKS OF INVASIVE SPECIES
SUBMISSION BY DIVERSITAS/GLOBAL INVASIVE SPECIES PROGRAM TO THE CBD IN DEPTH REVIEW OF INVASIVE ALIEN SPECIES

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1. Introduction

The 8th Conference of the Parties to the CBD expressed concern over 'gaps and inconsistencies' in the international regulatory framework (Decision VIII/27 of COP 8: Alien species that threaten ecosystems, habitats or species (Article 8 (h)), and has asked for inputs from the scientific community that bear on this issue as well as broader progress in the implementation of CBD decisions related to invasive species. To address the problem the ecoSERVICES core project of DIVERSITAS, in collaboration with the Global Invasive Species Programme, convened a meeting of leading invasive species scientists to consider what is currently known about the global drivers and local impacts of invasive species, and the way that these relate to the international regulatory framework[1].

From a scientific perspective there is a consensus that the main problem with the current regulatory system is that the onus of detection, interception, eradication and control of harmful introduced species is largely placed on host, or importing, countries. There are exceptions to this. The generic problem of species introductions includes human and livestock pathogens, and the international regulatory, monitoring and response regimes for such organisms are significantly more proactive than for other organisms. For most species introductions, however, the effectiveness of the current regulatory regime is limited by the resources that host countries are able to commit to national inspection, interception, detection, eradication and control programs.

We recommend that the CBD consider the following:

R1. Support establishment of a mechanism similar to the U.S.'s Center for Disease Control to provide information on invasive species other than human health pathogens, and the livestock and crop pathogens addressed by the World Animal Health Organization (OIE) and the International Plant Protection Convention (IPPC). This is a short term measure that is consistent with the current international regulatory framework. We anticipate that such a mechanism could assist countries to better use measures available under the current international regulatory regime. Specifically, it could:

- Provide countries wishing to take regulatory measures on invasive species with the expertise to evaluate the risks of novel species introductions to ensure consistency with the World Trade Organization's (WTO)

[1] The meeting took place Tempe, Arizona, on 29-31 October. A list of participating scientists is appended to this document.

Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).
- Provide Regional Trade Associations with the expertise to evaluate the consequences of spreading species through intra-regional trade.
- Enable individual countries to enhance their defensive capabilities, specifically by improving their capacity to apply robust risk assessment.

R2. Add the CBD to the list of organizations currently advising the WTO through the SPS and related agreements. The strong agricultural and health focus of the existing bodies advising the WTO exists for good historical reasons, but given the importance of interactions between ecological and other environmental change in the invasive species problem this is no longer adequate.

R3. Develop a Protocol on invasive species to: (a) systematize measures to address the national effects of global species dispersal, and (b) support international coordination of both preventive and defensive strategies.

The scientific background to these recommendations, and the rationale for each follows.

2. The science

There is a consensus that there are three main drivers of biological invasions. Two of these affect the invasibility or vulnerability of habitats. A third affects the invasiveness of species. The two main drivers of habitat change are climate and land use. The main driver behind species introductions, or propagule pressure, is the growth of world trade, transport and travel. There is also consensus that the impacts of climate change, land use and trade are not reflected in market prices, and so are generally ignored by decision-makers.

Climate change is expected to have both direct effects on species ranges and indirect effects on land cover and use. Species, including disease vectors, are already shifting into new areas in response to climate change. In fact, many (temperate zone) species and taxonomic groups have already moved into new areas. This trend will accelerate, and occur over increasingly large spatial scales. The establishment potential of long-distance migrants in natural and semi-natural vegetation will also increase. Areas of bioclimatic similarity that are sufficiently distant from each other are at particular risk of invasion.

In addition to climatically induced changes in the range of species, land use change induced largely by demographic and economic factors, is increasing the invasibility of habitats. Previously uninvaded habitats of high conservation value are particularly threatened by this trend, but all land use change that reduces the controlling role of potential predators, pests and pathogens on introduced species increases the risk that those species will become invasive. Land use change that increases the homogeneity of ecosystems in bioclimatically similar zones – as is increasingly the case in agricultural systems – has the same effect.

Against the background of increasing invasion risks due to climatic and land use change, change in the world trade regime is increasing the absolute number of species introductions, or propagule pressure. Three trends are particularly influential.

- First, the volume of world trade has increased significantly relative to world output due primarily to reduced transport costs, tariff rates and the relative price of tradable goods. This extends to trade in services: tourism is amongst the fastest growing sectors in most countries. In sum, the liberalization of world trade through the WTO's General Agreement on Tariffs and Trade has increased the openness or exposure of countries to species introductions.
- Second, the emergence and growth of Regional Trade Associations has further reduced barriers to trade within regions sharing contiguous boundaries. Intra-regional imports increased as a proportion of total imports since the 1980s. This trend has increased the potential for species introduced into any country in a regional grouping to be spread within the grouping.
- Third, the growth in world trade is currently concentrated in bioclimatically similar zones. Since trade between bioclimatically similar regions increases the likelihood that introduced species will become invasive, this trend makes it possible to identify high risk pathways.

The time scale over which the impacts of biological invasions are realized varies significantly. While some pests and pathogens move very rapidly (infectious human pathogens can spread globally in a matter of hours), others spread much more slowly. In fact the mean time to equilibrium is around 150 years. This is on the same timescale as issues like climate change, and it affects both the way that today's decision-makers weigh the costs of invasions (through the discount rate), and the choice of control strategy. For slow-moving species the best strategy tracks the current state of the system. For fast-moving species, the best strategy targets the equilibrium state.

Ecologically, the costs of invasive species stem from changes in provisioning, cultural and regulating ecosystem services. In some instances the impacts are either neutral or positive, as is the case with successful biocontrol agents or species that have become the basis for important economic activities. In other instances – those that concern the CBD – the impacts are negative. Future control measures will need to assess optimal paths for adapting ecosystems services, dependent communities and their continued functioning in biologically invaded habitats.

Pathogens are amongst the most important invasive species. The most significant emergent diseases in humans, wildlife, livestock and plants have, for example, all been driven by anthropogenic introductions. There is evidence that diseases have led directly to species extinctions. More generally, while we do not have accurate estimates of the impact of invasive species on GDP (or other common indicators of human well-being), estimates of the costs of specific pests and disease outbreaks indicate that emergent zoonotic diseases are amongst the most significant costs of the closer integration of the global system through world trade. Plant and animal invasions have more generalized ecosystem consequences, frequently transforming local systems in ways that affect a range of services. Invasions of such species have disproportionate consequences for

countries where a high proportion of people depend heavily on the exploitation of natural resources and/or where primary products account for a high proportion of GDP. This includes those low income countries where the majority of people depend on agriculture, forestry and fisheries for their livelihoods. Where these sectors are declining in relative importance, the impact of invasive pests is lower.

Economic analysis of the problem of biological invasions suggests that the current allocation of effort may not be efficient. Most strategies focus on defensive or adaptive measures, yet the evidence is that the 'cost of prevention is generally less than the cost of cure'. The reason for the bias lies in the rules of international trade. But it is also the case that nation states seldom evaluate the trade-offs between strategies. Where they exist, preventive strategies are normally little more than contractually agreed export standards – clean stock, container and/or vehicle programs in exporting countries. Defensive/adaptive strategies involve 'inspection and interception' and 'detection and control'. But these are not independent of one another. Inspection and interception at the point of entry is a substitute for the detection and control of established species (optimally doing more of one implies doing less of the other). On the other hand, inspection and interception or detection and control are complementary (optimally doing more of one implies doing more of the other).

In all cases, the evaluation of strategic options depends on the information available to the decision-maker(s). Since the introduction and establishment of invasive species frequently involves novel combinations of species, the outcome is uncertain and this too has implications for the best strategy. The risks associated with any introduction depends both on the probabilities attaching to different potential outcomes, and the value of each outcome. There is often uncertainty about both. In these circumstances the optimal strategy may be to invest in actions that enable either individual countries or groups of countries to learn about the risks. A Bayesian approach (by which the estimate of risk is updated on the basis of new information) is less effective in the case of individual countries than it is at the global level, indicating the advantage of multilateral collaboration. It is important that individual countries enhance their capacity to undertake appropriate risk assessment, but developing the capacity to understand global risks is likely to be more beneficial.

3. The specific recommendations

R1: Support establishment of a mechanism similar to the U.S.'s Center for Disease Control to provide information on invasive species other than human health pathogens, and the livestock and crop pathogens addressed by the World Animal Health Organization (OIE) and the International Plant Protection Convention (IPPC). Our first recommendation is designed to make better use of existing mechanisms. The SPS Agreement allows countries to restrain trade where it involves either proven harm to animal plant or human health, or where it involves a conjectured but unproven risk. In this case, however, the host country has finite time in which to

prove the risk. The net result is that for most potentially invasive species, the focus of effort is on independent defensive action by potential hosts. This includes inspection, interception, quarantine, detection, eradication and control facilities (often administered by separate bureaus). Since the onus of proof that introduced species are harmful rests with potential host countries, it also includes research into both the invasion processes and invasion impacts. Because the resources available to countries vary markedly, so does the efficacy of these various defensive efforts.

The empirical evidence is that the defensive measures admitted under the SPS Agreement, for example, are overwhelmingly exercised by middle and high income countries and even then only a small handful avail themselves of the full protections offered under the Agreement. Many low income countries are unable to offer any effective protection to either ecosystems or the people they support or even to determine the potential harm they face. Australia and New Zealand are held up as the gold standard in current conditions, but since both are developed countries without contiguous borders with any other state it is not clear that they are either viable or relevant models for most countries.

We see the establishment of a CDC-like mechanism as a way to empower nation states to use the defensive rights they already have under the SPS Agreement, but are frequently unable to exercise. We also see it as a way to provide constructive support to regional groupings, such as Regional Trade Agreements, for whom the coordination of defensive measures is critical.

Recognizing that there are trade-offs in approaches, prevention is generally recognized as the most cost-effective strategy for minimizing the threat of invasive species, when specific measures are properly evaluated and designed to be the most cost-effective and least restrictive to trade. This has three major implications for regulatory and management activities:

1) Pathways: pathway-based efforts to prevent the introduction and spread of invasive alien species should focus on all stages of the process and not simply rely on border inspection (i.e., should consider the point of origin, transit and destination); and
2) Risk evaluation: the proper conduct of risk assessments and evaluation of management actions can maximize protection, minimize other impacts (e.g., inhibiting movement of traded goods) and still be consistent with international trade rules.
3) Win-win solutions: Maintaining pest-free agricultural, aquatic and forestry systems, as well as public health, can reduce environmental risks while also maintaining economic competitiveness as clean export products are better able to meet other countries' SPS regulations, and biosecurity investments can benefit both production sectors and the environment.

R2: Add the CBD to the list of organizations currently advising the WTO on the environmental implications of trade through the SPS and related agreements

The dominant effect of the current international regulatory system is that primary responsibility for inspection, interception, detection, eradication and control of invasive species lies with host countries. Although accidental/unintended species introductions are an externality of international trade, there is a strong institutional bias against the internalization of such costs. The WTO's primary mission is to secure the benefits of world trade liberalization, and actions that are seen to be in restraint of trade are admitted only where there are demonstrable negative impacts on plant, animal or human health. The invasive species risks of international trade are addressed through the SPS Agreement, informed by the IPPC, OIE and Codex Alimentarius – a joint initiative of the Food and Agriculture Organization and the World Health Organization. It is not informed by the CBD.

Given the interdependence between biodiversity change, the impacts of species introductions and trade we consider that it is appropriate for the CBD (represented by a body such as that described in **R1**) to inform the WTO both through instruments such as the SPS Agreement and more directly. Since Article XX of the General Agreement on Tariffs and Trade and the SPS Agreement has not provided sufficient protection to biodiversity (measured in terms of human, plant and animal health) there is a need for a more systematic CBD input into the WTO process than has historically been the case.

R3: Develop a Protocol on invasive species to: (a) systematize measures to address the national effects of global species dispersal, and (b) support international coordination of both preventive and defensive strategies.

The CBD asserts that "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, *and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction*" (our emphasis). The Convention deals extensively with the first part of this statement, and not at all with the second part. Indeed, there is very little in the agreement itself that addresses the transboundary risks created by economic activities that move species, either intentionally or unintentionally.

We consider that the magnitude of the international threat posed by the accelerating dispersal of species and the haphazard implementation of existing CBD guidance, indicate the need for a dedicated agreement on this issue, potentially in the form of a Protocol to the Convention. Aside from the lack of guidance in the CBD, we note that an important consequence of the focus on defensive strategies is that there is little incentive to coordinate strategies between countries. Where countries share common borders, and where there are no restrictions on trade between them, strategies to regulate invasion pathways are largely ineffective. The level of protection against invasive species enjoyed by all such countries is only as great as the level of protection offered by the weakest of them. The current treatment of human pathogens is different in this respect than the treatment of other potentially invasive species, but wherever invasive species control is a

'weakest-link public good' there is a strong case for coordinating national responses. Bilateral and regional communication is therefore critical for effective prevention and control of invasive species, whether for countries with contiguous borders, island chains or regional and bilateral trading partners.

We believe that a Protocol on Invasive Species would be an appropriate mechanism to address both national responsibility for the wider consequences of species export, and the resulting need to coordinate both preventive and defensive measures.

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Appendix 1: Participants at the DIVERSITAS workshop on invasive species, Tempe, Arizona, 29-31 October 2007.

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David Cook	CSIRO	Australia
Chris Costello	University of California, Santa Barbara	USA
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Gustavo Garduno*	Arizona State University	USA
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Steven Hovick*	University of Georgia	USA
Ann Kinzig	Arizona State University	USA
Maya Kapoor*	Arizona State University	USA
Reuben Keller*	Notre Dame University	USA
Elisabeth Larson*	Arizona State University	USA
David Lodge	Notre Dame University	USA
Mark Lonsdale	CSIRO	Australia
Hal Mooney	Stanford University	USA
Mark New	Oxford University	UK
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Uma Shaanker	University of Bangalore	India
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David Simpson	Johns Hopkins University	USA
Mike Springborn*	University of California, Santa Barbara	USA
Chris Thomas	University of York	UK
Julia Touza	UFZ	Germany
Brian van Wilgen	CSIR, South Africa	South Africa
Mark Williamson	University of York	UK

Appendix 2: Future research needs identified at the DIVERSITAS workshop on invasive species, Tempe, Arizona, 29-31 October 2007.

POLICY PRESCRIPTIONS

1. A taxonomy of when "rules of thumb" are good enough, and when more detailed optimal-path strategies need to be identified.
2. Improved understanding of how policymakers "hear" information; potential bundling of recommendations to reduce likelihood that you've saturated their ability to hear.

THREAT ASSESSMENT

3. More comprehensive assessments of threats, primarily within a framework of ecosystem services.
4. Improved identification of main pathways of invasion threat, including trade, historic connections and biogeography.
5. Greater understanding of invasive species' effects on non-tangible, non-marketed services such as cultural and regulating services.
6. Greater understanding of the patterns and rates of spread.
7. Better incorporation of climate change in temporal analyses of invasive species policies, including the impacts of climate-change mitigation/adaptation policies on invasions.
8. Expanded understanding of the drivers of change—beyond climate and trade to include invasibility (e.g., habitat, population and community structure, "taxonomic vulnerability") and management strategies to reduce invasibility.

MANAGEMENT TRADE-OFFS/INTERACTIONS

9. How "optimal strategies" change when one considers strategies of neighbors (e.g., weakest links or those failing to act).
10. Development of "strategic portfolios" of inspection, detection, and control and the cost of (complicated) management strategies.
11. How the identification of optimal management strategies should include the value of information and (non)compliance.

ADAPTATION VERSUS MITIGATION

12. Optimal strategies for adaptation to invasive species after mitigation has failed.

VALUES, PREFERENCES, EQUITY

13. The distribution of costs and benefits of invasion across income groups (individuals versus nations), and consequent considerations for evaluating the benefit or detriment of an introduced species.
14. Better understanding of the preferences, values, and incentives driving behavior, including the risk portfolio of society (particularly vis-à-vis low probability/disastrous events).