Globalization and the Dispersion of Species: The Economic Problem

Twenty-first Century Ecosystems: Systemic Risk and the Public Good
A NAS Symposium on the Science and Policy for Managing the Living World Two Centuries after Darwin

Charles Perrings
ecoSERVICES Group
School of Life Sciences
Arizona State University

Charles.Perrings@asu.edu
http://www.public.asu.edu/~cperring/

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What are invasive species?

- The Convention on Biological Diversity defines invasive species as alien or non-native species that are introduced, established and spread and that are potentially damaging.

- Examples:

The risks of invasive species increase with...

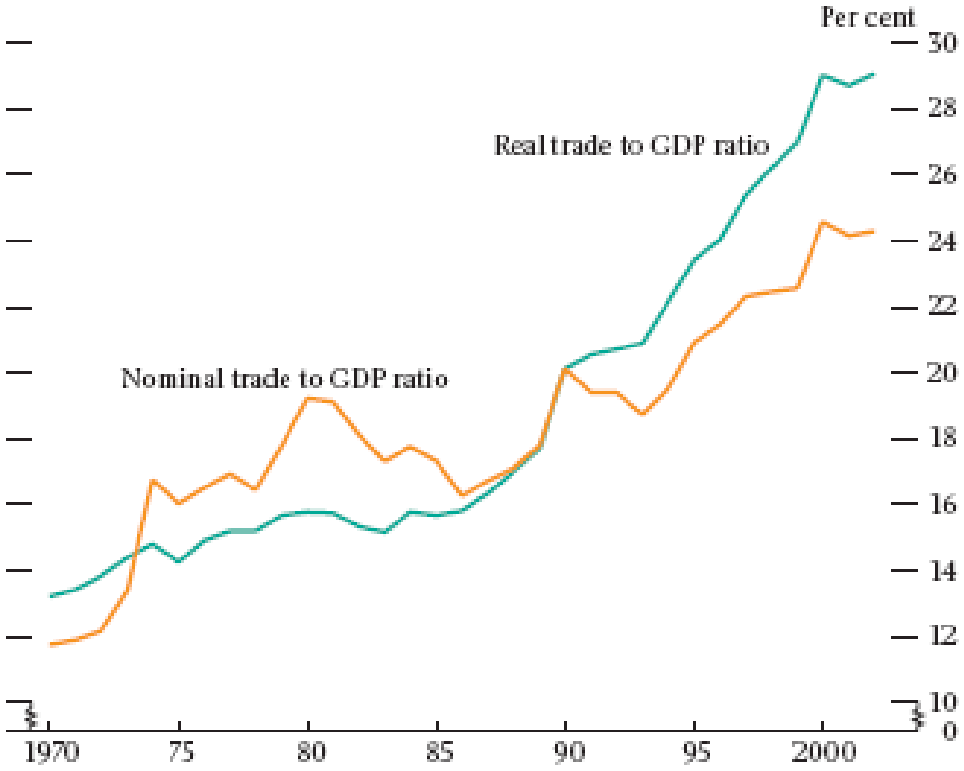
- the integration of the world economy (the increasing volume of trade, aid, transport and travel);
- the invasiveness of the species (a property of species traits, including plasticity);
- the vulnerability of the host system to invasion (as a result of disturbance, including fragmentation and species loss);
- the bioclimatic similarity and geographical distance between source and host countries.

The world economy is becoming more integrated…..

The volume of world trade has increased significantly relative to world output due to:

- GDP per head (+);
- transport costs (-);
- tariff rates (-);
- exchange rate volatility (-);
- price of tradable relative to non-tradable goods (-).

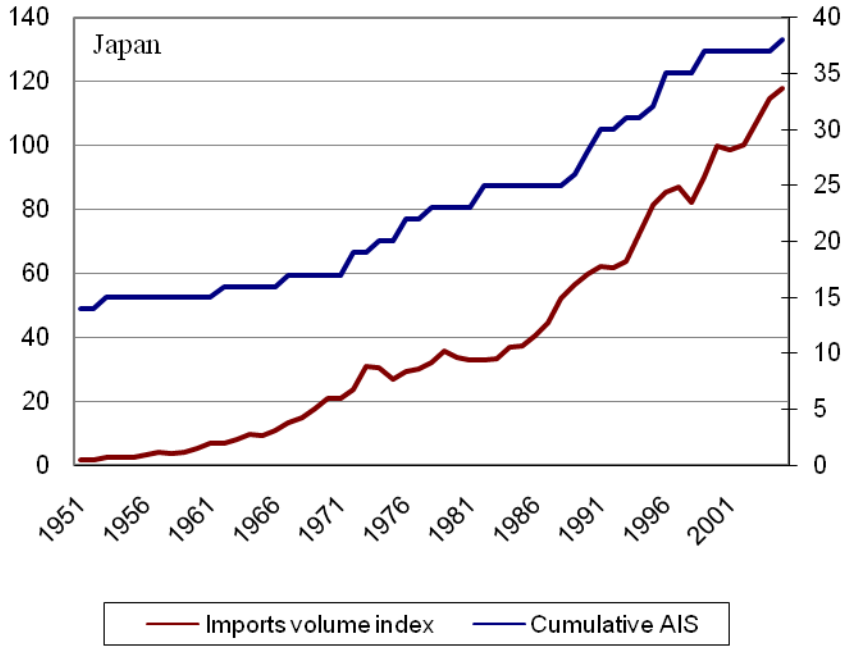
World imports as a ratio of world GDP: nominal and real



Dean M. & Sebastia-Barriel M. 2004. Why has world trade grown faster than world output? *Bank of England Quarterly Bulletin, Autumn 2004*: 310-320.

Invasive species and trade volumes are positively correlated

- Species introductions increase with trade volumes
- Every container of imports and every passenger contains a sample of the organisms in the country of exports
- Increase in the speed of trade increases the likelihood of their survival

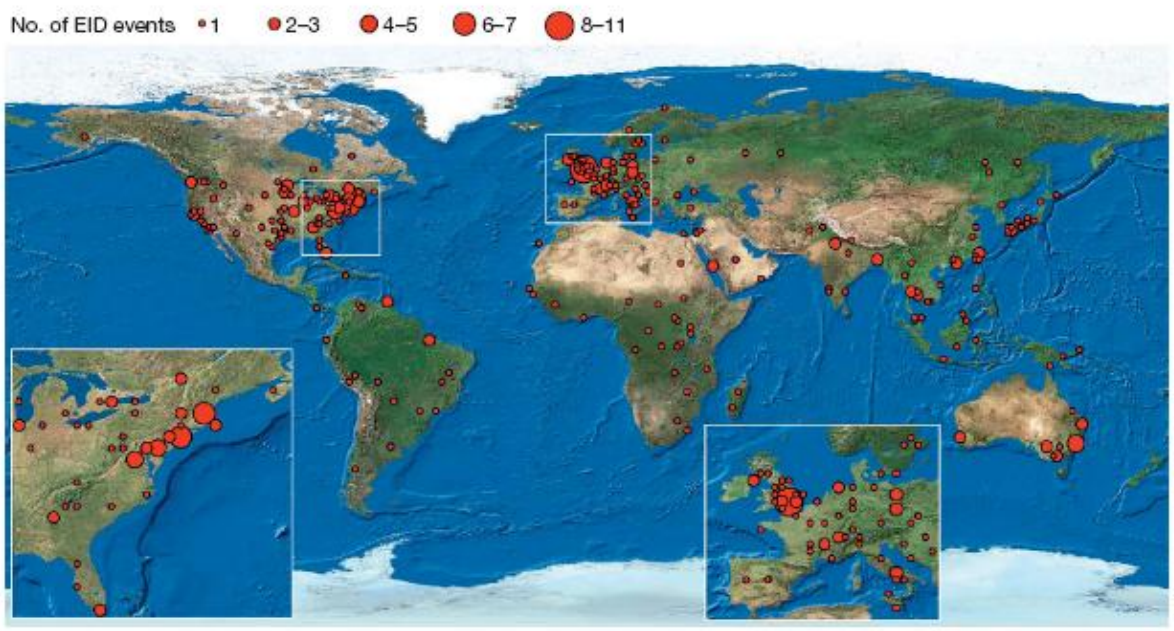


WTO International Trade Statistics.

Infectious disease risks are related to the growth of trade and travel

- The risks of emerging infectious diseases are determined by economic, environmental and ecological factors, particularly the volume of imports.

- There is a substantial risk of wildlife zoonotic and vector-borne EIDs originating at lower latitudes where reporting effort is low.



Jones K.E, N.G. Patel, M. A. Levy, A. Storeygard, D. Balk, J. L. Gittleman and P. Daszak (2008) Global trends in emerging infectious diseases, Nature 451(21): 990-994.

Invasive species and aid volumes are also positively correlated

- The risks from aid are higher than the risks from trade because it is subject to lower sanitary and phytosanitary standards.

- Example: Grey leaf spot reported in South Africa in 1988 and has now spread into all the main maize-growing areas of Africa (Rangi, 2004). It was introduced in US food aid shipments of maize in during the 1980s drought 1980's (Ward et al, 1999).

- Parthenium weed from Mexico was first detected in Ethiopia in 1988 near food-aid distribution centers. It had accompanied wheat grain distributed as food aid during the same drought (GISP, 2004).

Rangi D.K. 2004. Invasive alien species: agriculture and development, Proceedings of a global synthesis workshop on biodiversity loss and species extinctions: managing risk in a changing world, UNEP, Nairobi.
Ward J.M.J., E.L. Stromberg, D.C. Nowell and F.W. Nutter. 1999. Gray leaf spot: a disease of global importance in maize production, Plant disease 83: 884-895.
Global Invasive Species Program (GISP). 2004. Africa invaded: the growing danger of invasive alien species, GISP, Capetown

Trade patterns and species introductions

- Trade between bioclimatically similar regions increases the likelihood that introduced species will become invasive

- Regional Trade Agreements open up new trading opportunities between countries which:
  - brings closer linkages between ecosystems in which bioclimatic conditions are broadly similar
  - consequently increases the risk that introduced species will establish, naturalize and spread

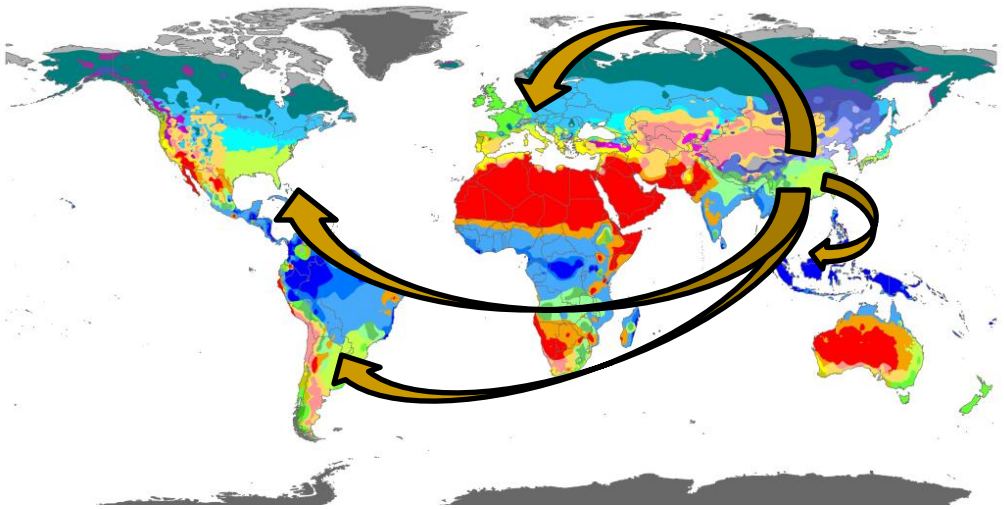
- Example: NAFTA has encouraged spread of species within North America of species introduced to one NAFTA country from some other country (Perrault et al, 2003).

Perrault A., M. Bennett, S. Burgiel, A. Delach, and C. Muffett, 2003. *Invasive Species, Agriculture and Trade: Case Studies form the NAFTA Context*, North American Commission for Environmental Cooperation, Montreal.

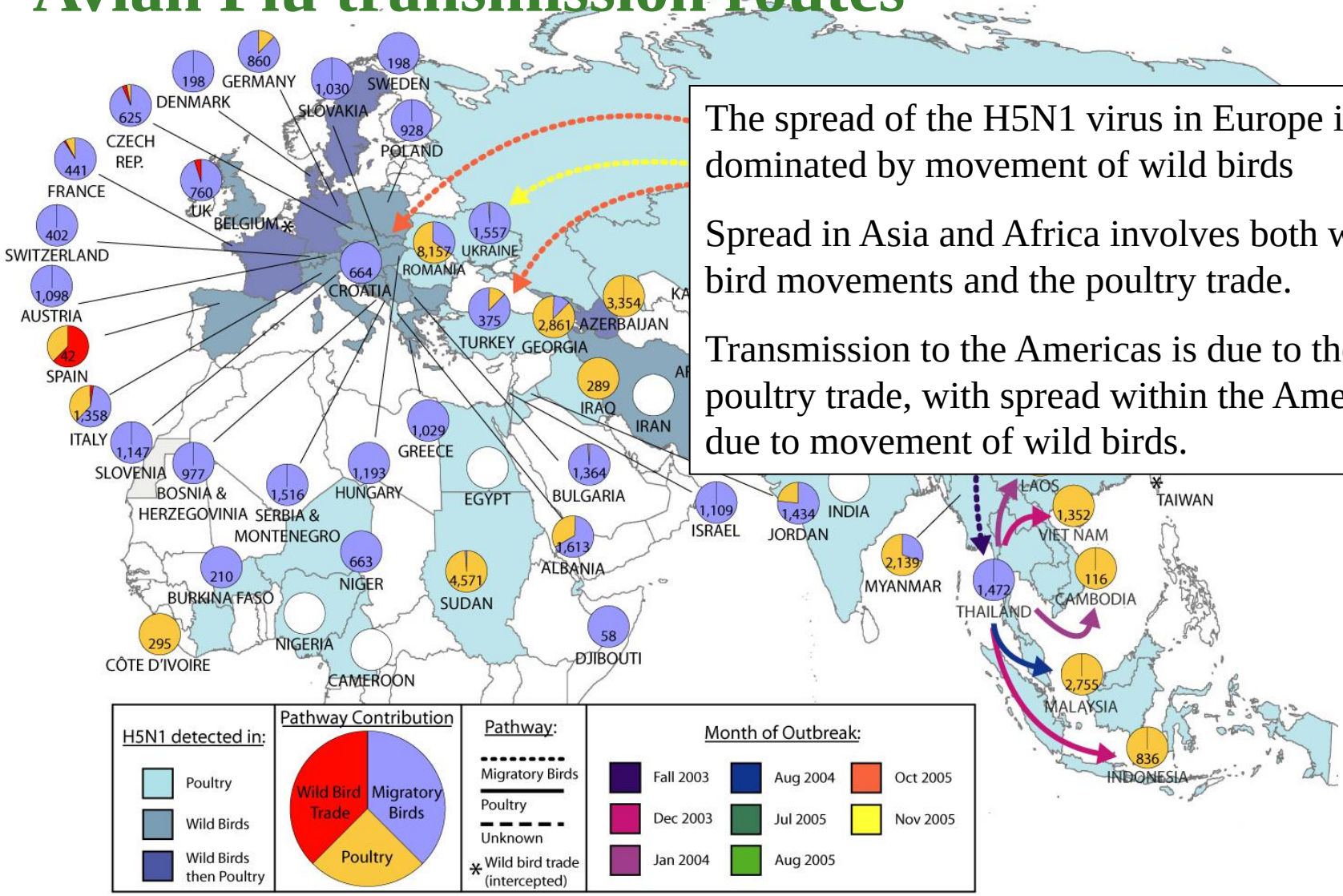
The likelihood that introduced species will establish increases with the bioclimatic similarity between trading partners

- Changes in the pattern and composition of trade affects the bioclimatic similarity between trading partners
- Example: the growth of trade with China affects the invasive species risks faced by China's trading partners

Source: World Bank data.



Avian Flu transmission routes



The spread of the H5N1 virus in Europe is dominated by movement of wild birds

Spread in Asia and Africa involves both wild bird movements and the poultry trade.

Transmission to the Americas is due to the poultry trade, with spread within the Americas due to movement of wild birds.

Kilpatrick A.M., Aleksei A. Chmura, David W. Gibbons, Robert C. Fleischer, Peter P. Marra, and Peter Daszak (2006) Predicting the global spread of H5N1 avian influenza, *PNAS* 103(51): 19368–19373.

The costs of invasive species

USD (2000) billion pa

There are no good estimates of the global cost of invasive species. One example is from Pimentel et al (2001):

Introduced pest	United States	United Kingdom	Australia	South Africa	India	Brazil	Total
Plants	0.148	–	–	0.095	–	–	0.178
Mammals							
Rats	19.000	4.100	1.200	2.700	25.000	4.400	56.400
Other	18.106	1.200	4.655	–	–	–	23.961
Birds	1.100	0.270	–	–	–	–	1.370
Reptiles/Amph.	0.006	–	–	–	–	–	0.006
Fishes	1.000	–	–	–	–	–	1.000
Arthropods	2.137	–	0.228	–	–	–	2.365
Mollusks	1.305	–	–	–	–	–	1.305
Livestock Diseases	9.000	–	0.249	0.100	–	–	9.349
Human Diseases	6.500	1.000	0.534	0.118	–	2.333	10.467
Total	58.299	6.570	6.866	3.013	25.000	6.733	106.481

Source: Pimentel et al (2001)

Pimentel, David, S. McNair, S. Janecka, J. Wightman, C. Simmonds, C. O'Connell, E. Wong, L. Russel, J. Zern, T. Aquino and T. Tsomondo, 2001, Economic and environmental threats of alien plant, animal and microbe invasions, *Agriculture, Ecosystems and Environment* 84:1-20.

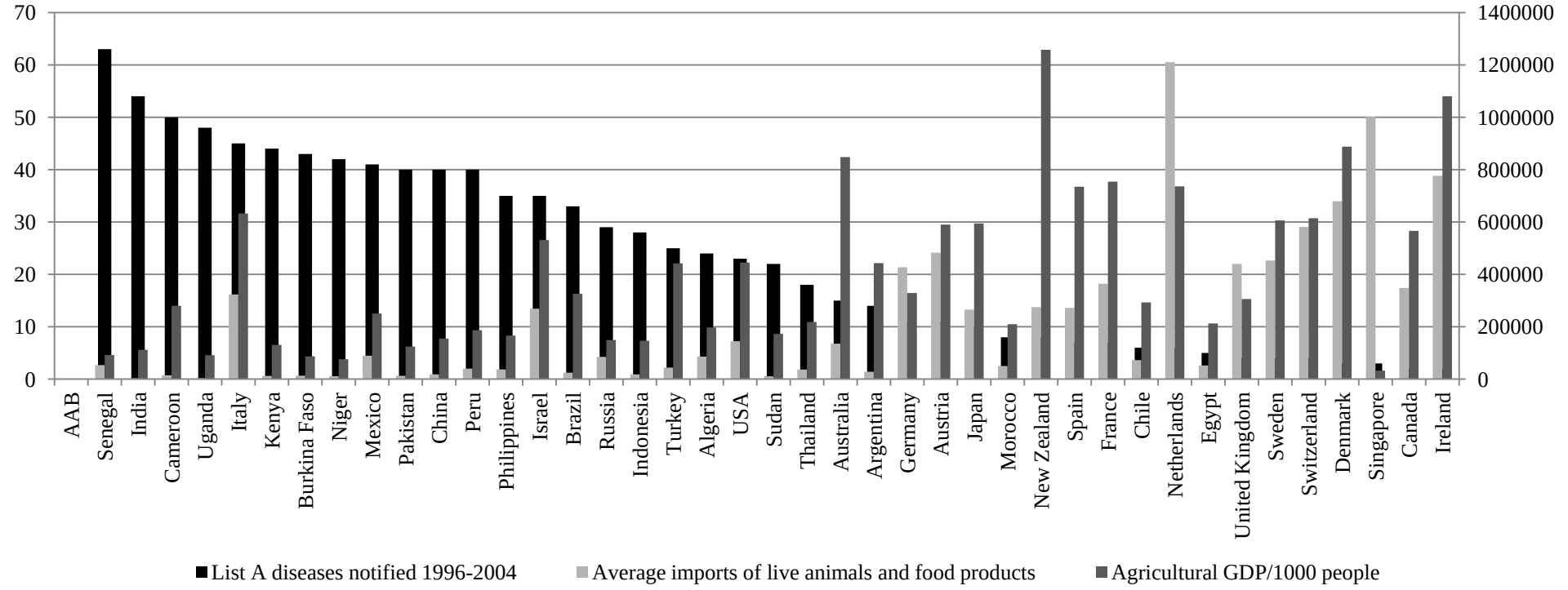
SPS measures and species introductions

- The effect of trade growth can be moderated by SPS regimes.
- Example: dispersal of animal pathogens reported to the OIE 1996-2004
- For all notifiable pathogens taken together outbreaks increase with both the volume of imports of risk materials and the value at risk.
- For List A species (especially fast growing, harmful) outbreaks decrease with both trade volumes and value at risk.

LIST A DISEASES

Foot and mouth disease
Vesicular stomatitis
Swine vesicular disease
Rinderpest
Peste des petits ruminants
Contagious bovine pleuropneumonia
Lumpy skin disease
Rift Valley fever
Bluetongue
Sheep pox and goat pox
African horse sickness
African swine fever
Classical swine fever
Highly pathogenic avian influenza
Newcastle disease

List A diseases notified, Average Agricultural GDP per capita and Average imports of risk materials, 1996-2004



Perrings C., A. Kinzig and E. Fenichel 2009. Globalization and invasive species: trade pests and pathogens. In C. Perrings, H.Mooney and M. Williamson (eds), Globalization and Bioinvasions: Ecology, Economics, Management and Policy, Oxford, OUP.

Options open to the US administration

Nationally

- Enhance border surveillance against imports/exports of invasive harmful species

- Establish and fund an interagency center to coordinate federal, state, and local efforts to prevent the export or import of invasive species, and control the spread of established species

Options open to the US administration

Internationally

The problem of invasive species is global, and needs to be addressed at a global level by strengthening relevant MEAs, enhancing monitoring and information, and coordinating international responses.

- Take a leadership role in the CBD, the WTO, the WHO, the OIE and the IPPC to strengthen SPS requirements on exporters
- Establish an international CDC-like mechanism to provide countries with the information needed to protect themselves/others in terms of the GATT and SPS Agreement
- Establish and fund an international mechanism to coordinate the actions of international bodies with responsibilities for pieces of the invasive species problem

The New Yorker…

"And in this section it appears that you have not only alienated voters but actually infected them, too" (New Yorker, Dec 17, 2005).