International
BIOLOGICAL THREAT REDUCTION

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Biological Threat Reduction

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

NNSA National Nuclear Security Administration

Sandia National Laboratories

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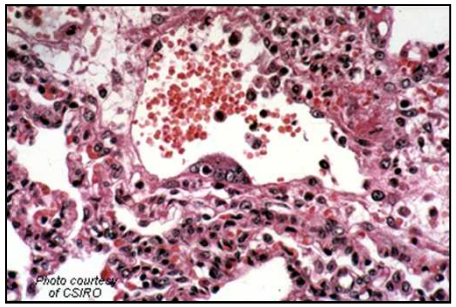
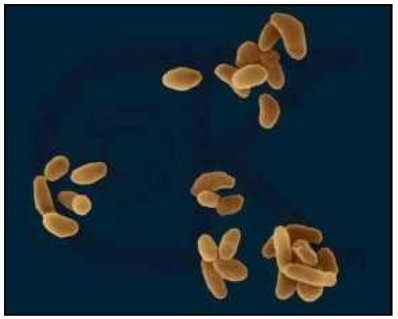
Introduction

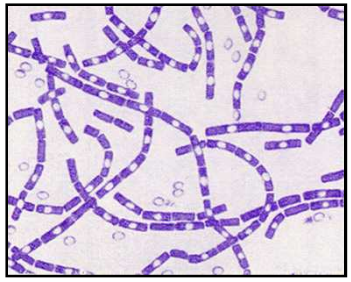
- **Historically, field of infectious disease distinct from that of biological weapons**
  - **Biological weapons limited to States and national security experts**
  - **Infectious disease limited to physicians and veterinarians**
- **Within the last five years, all of that has changed**
  - **Now we need close collaboration between these diverse experts**
  - **New ethical concerns for the life science community**



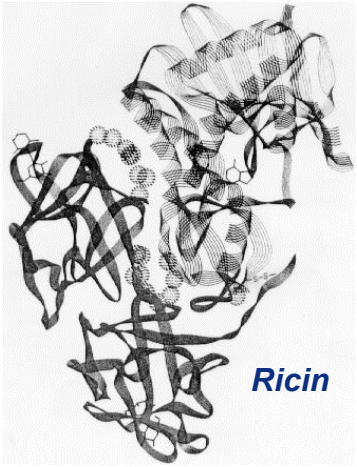
Nipah virus



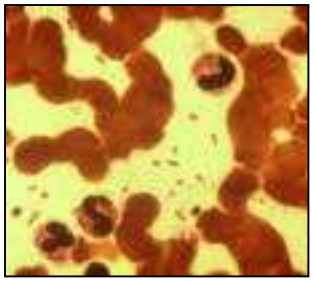
Francisella tularensis



Bacillus anthracis



Ricin



Yersinia pestis

Smallpox virus

History of Biological Weapons

- **1346: Tartar invaders catapulted plague-infected bodies over city walls during siege of Kaffa**

- **1754-1767: During French-Indian wars, British soldiers distributed blankets used by smallpox victims to Native Americans loyal to the French**

- **World War I**
  - **Germany, France - anti-livestock sabotage**
- **World War II – 1972**
  - **Japan, USSR, US, UK, Canada**
    - **Japanese use against Chinese targets**
    - **Alleged Soviet use against German soldiers**

Biological Weapons Convention (BWC)

- Prohibits the development, production, and stockpiling of biological weapons agents, toxins, equipment, and means of delivery by State Parties

- Opened for signature April 1972; entered into force March 1975
  - 171 State Parties (16 signatories have not ratified; 23 non-signatory nations)

- No provisions for verification of compliance
  - Dual-use nature of biological materials, technologies, and expertise present significant challenges
  - Extreme difficulty of discerning between legitimate and illegitimate biological research

Failure of the BWC

- **Biopreparat: The civilian arm of the Soviet biological weapons program**
  - **Established *after* Soviet accession into the BWC**
  - **40 – 50 facilities with up to 60,000 employees**
- **Other incidents**
  - **Assassination of Bulgarian dissident**
  - **Alleged South Africa program to assassinate opponents of apartheid**
- **Other suspected BW programs since 1972**
  - **Iran, North Korea, Syria, Sudan, Cuba**

Production Facility in Kazakhstan

Munitions in Iraq

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Voz Island, Central Asia

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Voz Island, Mid-1990s

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Voz Island, November 2000

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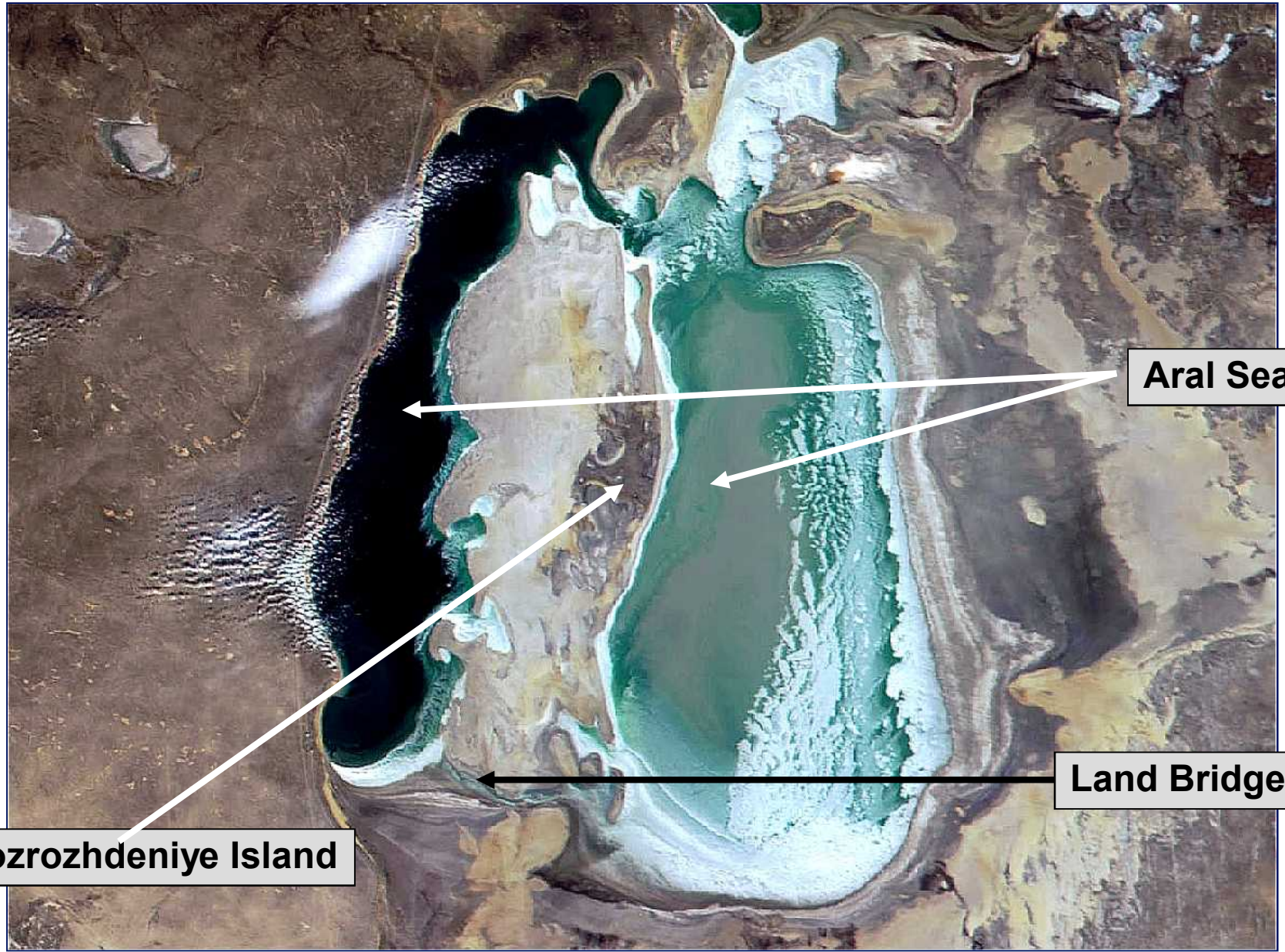
Voz Island, June 2002



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Origins of Bioterrorism

- In 1910, the Pancho Villa guerillas used shards of pottery and obsidian laced with botulinum toxin to attack federal sentries
- In 1952, the Kenyan Mau Mau separatist group used African milk brush toxin to poison steer
- In 1981, Dark Harvest, an environmental extremist group in the United Kingdom, delivered anthrax-contaminated soil to a political party conference
- In 1984, Rajneeshees cult contaminated restaurant salad bars in The Dalles, Oregon with salmonella bacteria
- In 1995, Larry Wayne Harris was arrested after receiving three vials of *Yersinia pestis* from the American Type Culture Collection under false pretenses
- In 1996, Diane Thompson tainted donuts at her place of work with *Shigella dysenteriae* Type 2 in an attempt to sicken her co-workers

Bhagwan Shree Rajneesh

Gruinard Island, UK

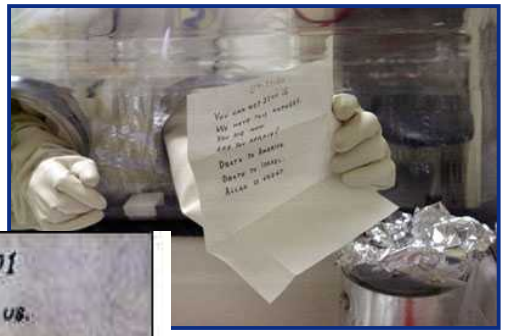
Larry Wayne Harris

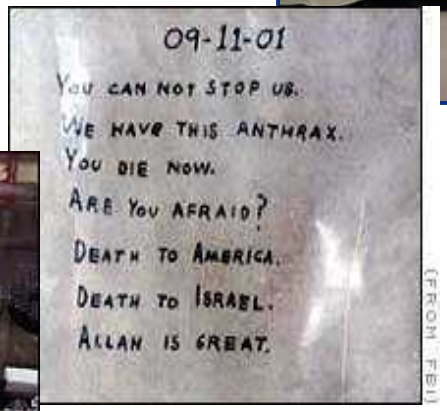
Escalation of Bioterrorism

Aerosolization of Bacillus anthracis and botulinum toxin by Aum Shinrikyo

- **Aum Shinrikyo – 1990s**
  - Aerosolized and disseminated biological agents in Tokyo
    - Vaccine strain of ***Bacillus anthracis***
    - Inactive strain of ***Clostridium botulinum***

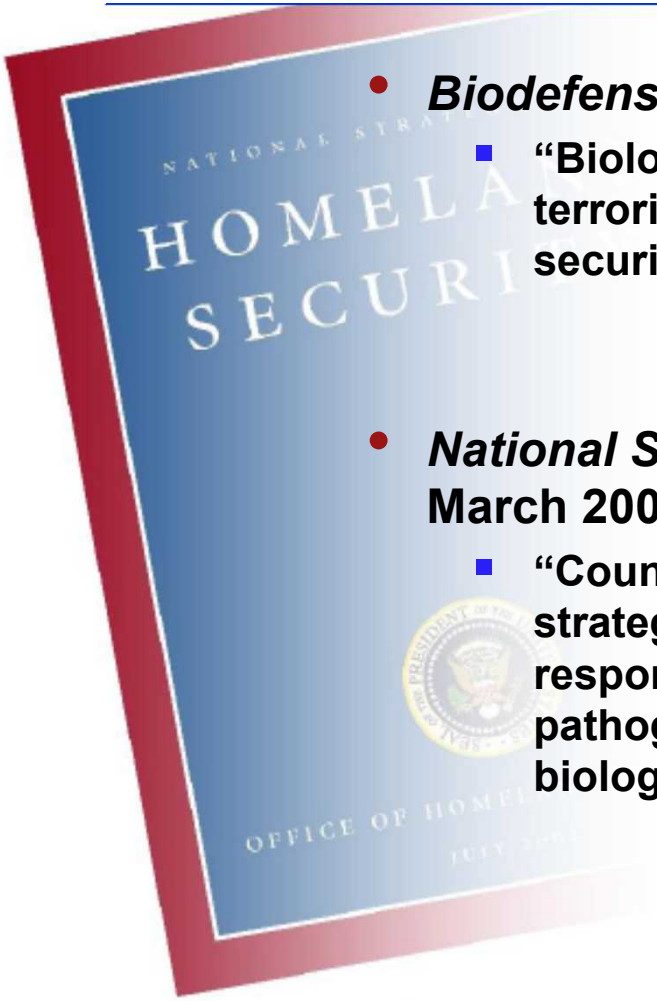
- **US anthrax attacks – 2001**
  - Highly refined: 4-7 letters contaminated over 60 different sites
  - Highly virulent: killed 5, injured 22





Amerithrax

New United States Policy



- ***Biodefense for the 21st Century*, White House, April 2004**
  - **"Biological weapons in the possession of hostile states or terrorists pose unique and grave threats to the safety and security of the United States and our allies."**

- ***National Security Strategy of the USA*, White House, March 2006**
  - **"Countering the spread of biological weapons requires a strategy focused on improving our capacity to detect and respond to biological attacks, securing dangerous pathogens, and limiting the spread of materials useful for biological weapons."**

US Government Funding and Programs

- $36B since 2001
  - $1.5B in 2001
  - $8B in 2007
- Biodefense
  - 98% of the funding
  - A *domestic* strategy designed to reduce the consequences of bioterrorism
  - Enhance the ability of the US to respond to the next bioterrorist attack
- Biological weapons nonproliferation (BWNP)
  - 2% of the funding
  - An *international* strategy designed to prevent the development, use, and spread of biological weapons by states
  - Focus on Russia and the states of the Former Soviet Union

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Evolution of the Biological Threat

- The biological threat has evolved in concert with
  - Increasing emergence and reemergence of highly infectious disease
  - Advance of biotechnology globally
  - Rise of transnational, asymmetric terrorism
- This recent "globalization" of the biological threat has broadened the availability of materials, technologies, and expertise needed to maliciously disseminate infectious disease

Mt. Merapi, Yogyakarta, Indonesia

Infectious Disease

- Global outbreaks of emerging and reemerging infectious disease present a growing threat to international security
- Most dangerous infectious diseases are often tropical diseases that emerge in developing countries
- Infectious diseases now spread across borders as never before
- Natural outbreaks represent unpredictable sources of dangerous pathogens for terrorists

SARS virus

FMD outbreak, UK

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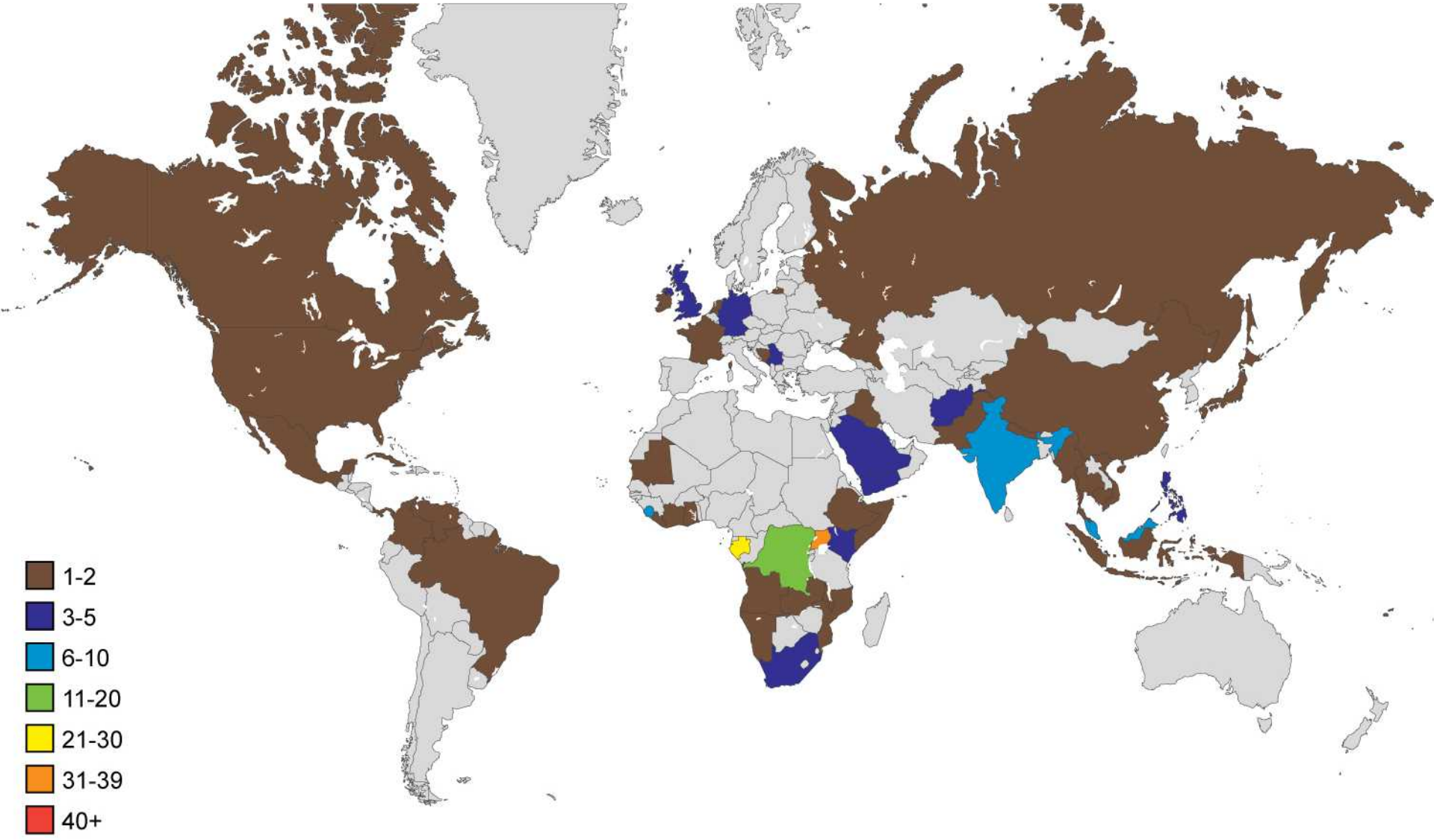
WHO Outbreak Reports for Emerging Infectious Diseases 1996-2000



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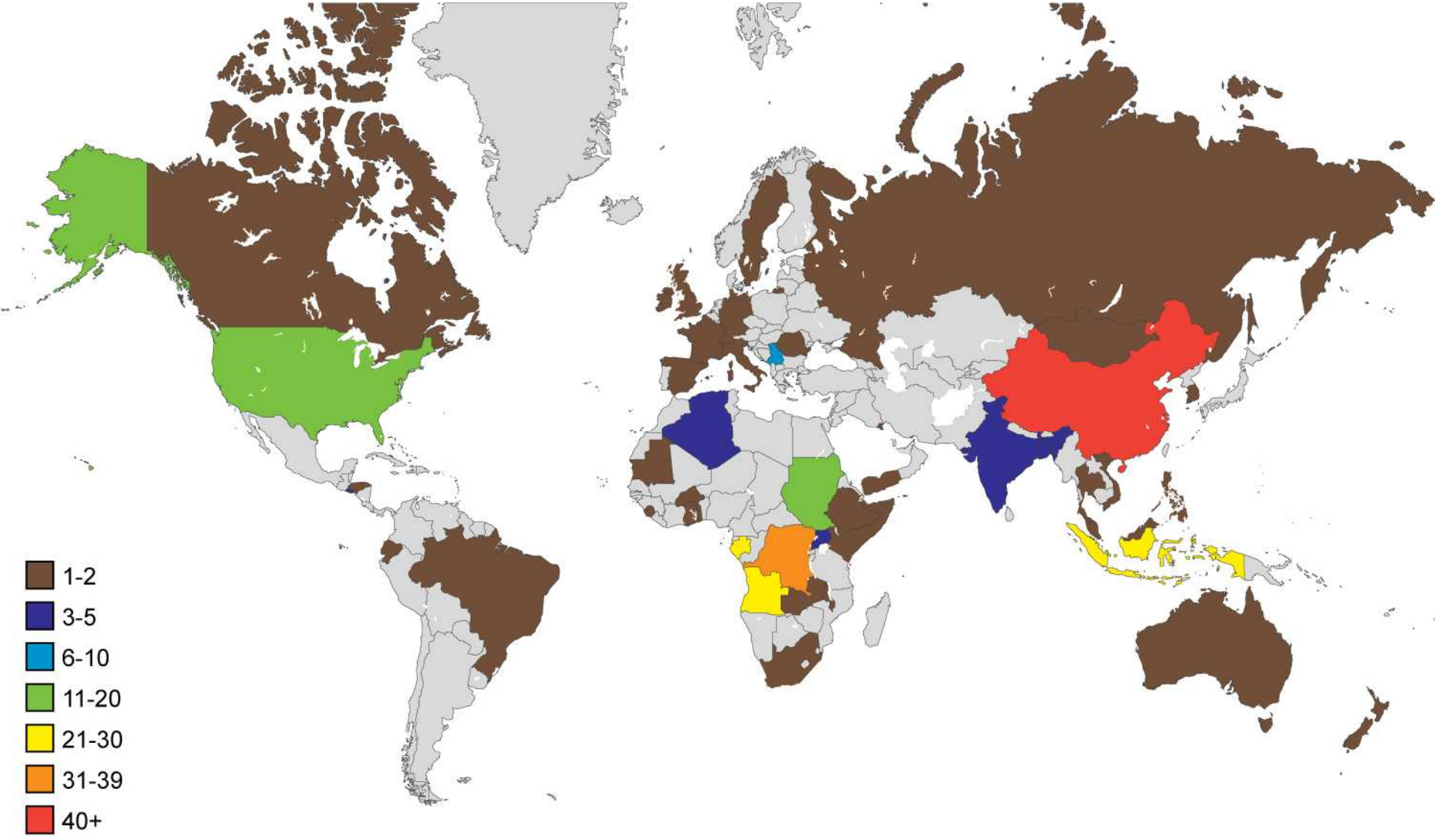
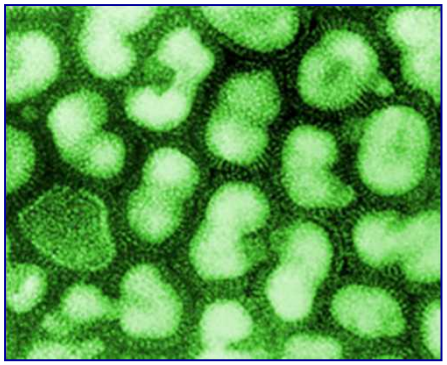
WHO Outbreak Reports for Emerging Infectious Diseases 2001-2005

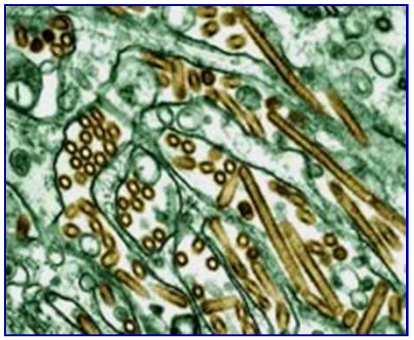


Highly Pathogenic Avian Influenza

- **H5N1 strain of highly pathogenic avian influenza first emerged in 1997 and has spread to over 50 countries**
  - **Over 229 people infected, at least 131 fatalities**
  - **Has also infected other mammals**
- **Sequencing of the 1918 pandemic influenza virus revealed that H5N1 is very similar *(Taubenberger 2005)***
  - **Unlike the strains of the 1958, 1967 pandemics**



Avian influenza virus



- **The virus is evolving**
  - **Strain in Turkey had mutations that made it more adapted to humans than birds**
  - **Strain in Vietnam resistant to Tamiflu®**
  - **Confirmed human-to-human transmission in Indonesia**

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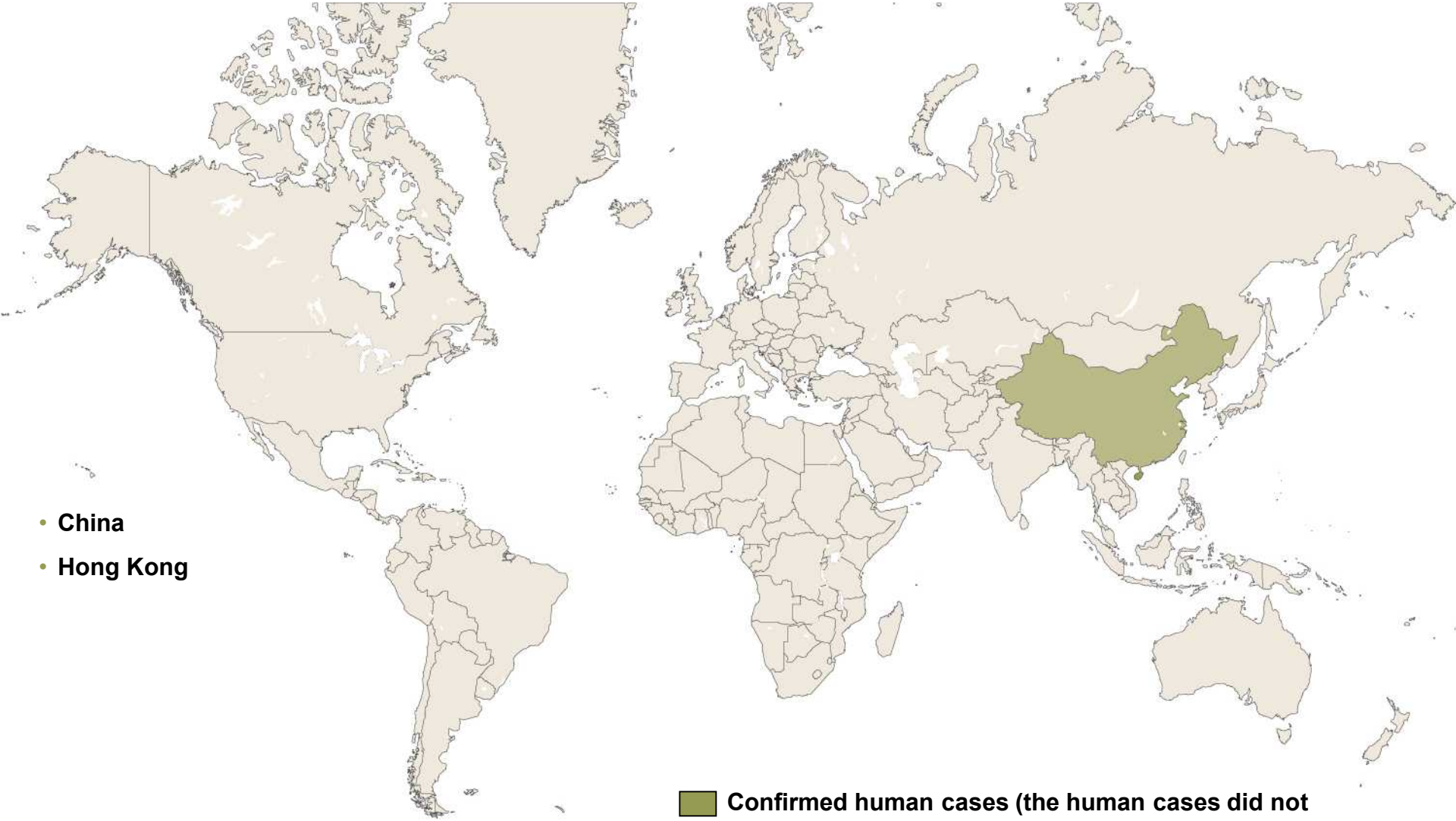
Highly Pathogenic Avian Influenza H5N1—1997



- China
- Hong Kong

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

Confirmed animal cases

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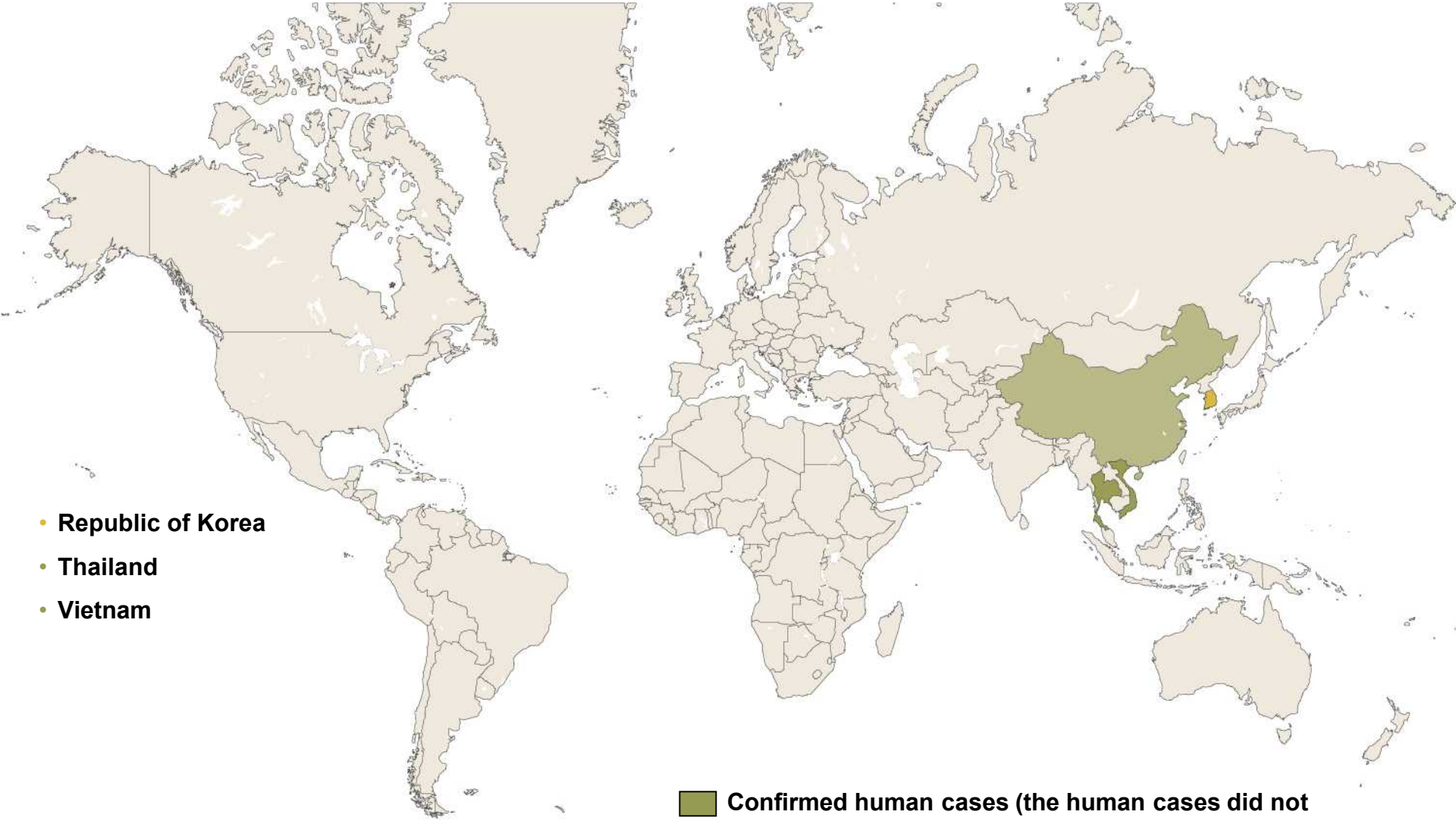
Highly Pathogenic Avian Influenza H5N1—2003



- Republic of Korea
- Thailand
- Vietnam

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

Confirmed animal cases

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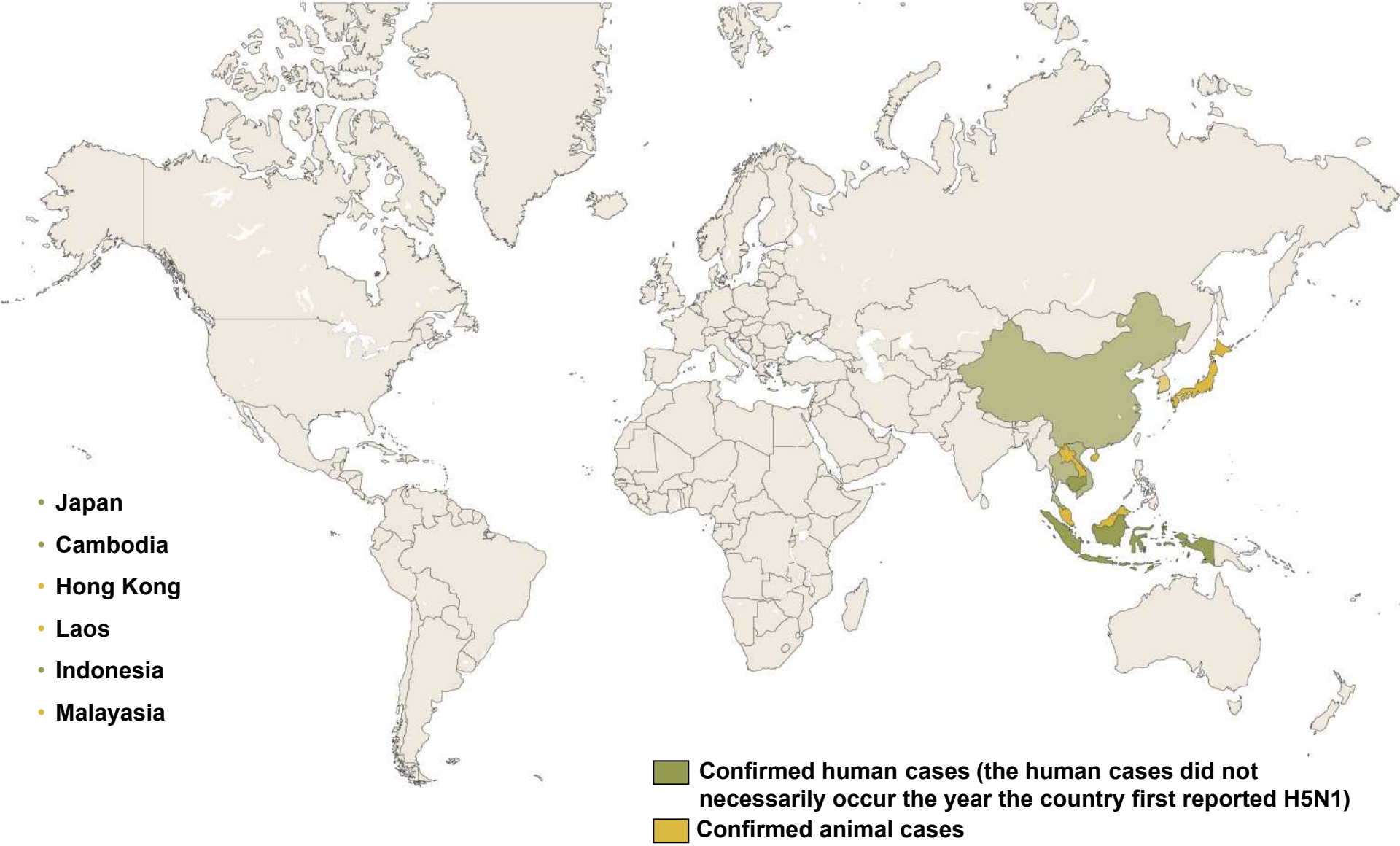
Highly Pathogenic Avian Influenza H5N1—2004



- Japan
- Cambodia
- Hong Kong
- Laos
- Indonesia
- Malayasia

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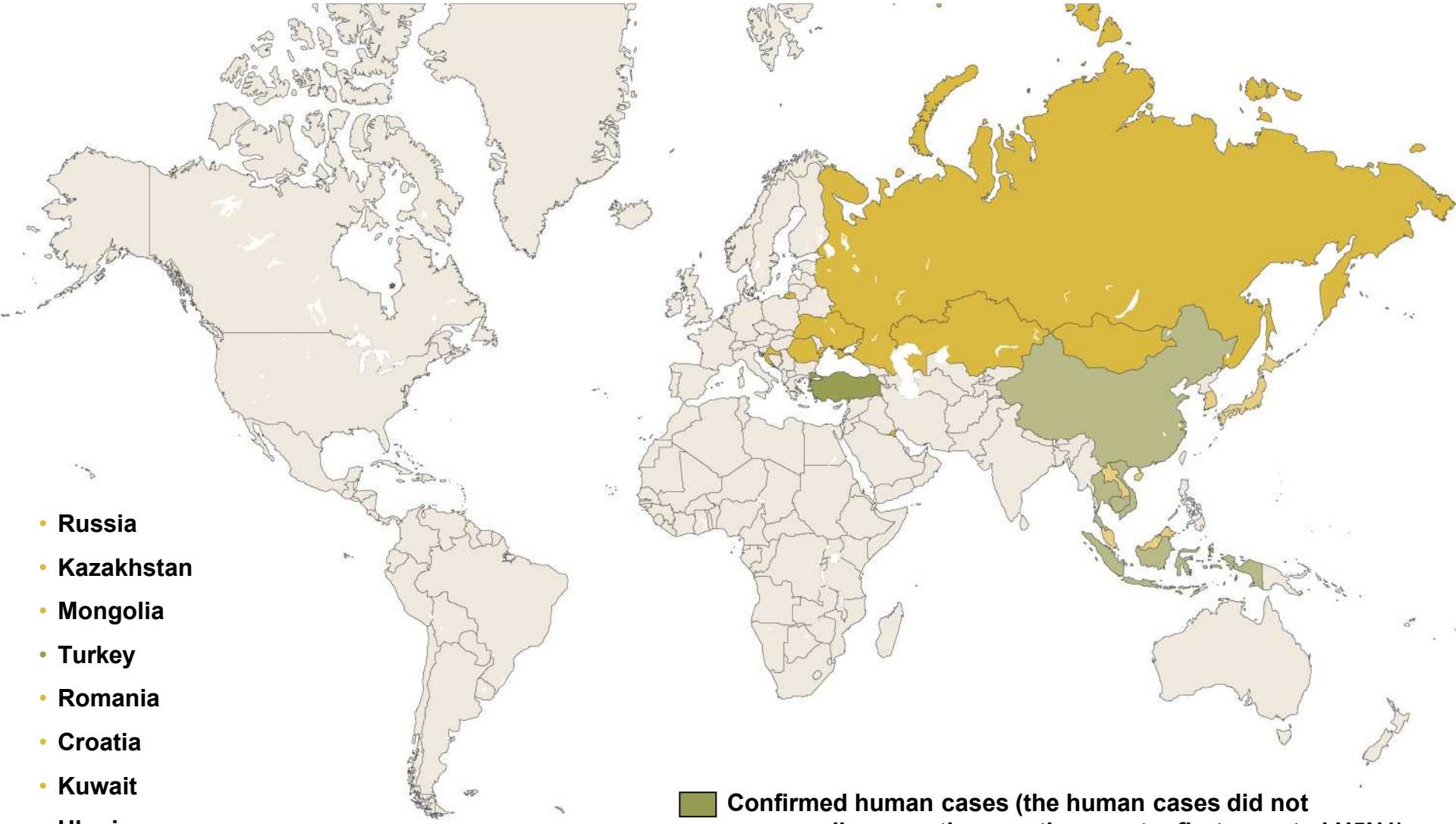
Highly Pathogenic Avian Influenza H5N1—2005



- Russia
- Kazakhstan
- Mongolia
- Turkey
- Romania
- Croatia
- Kuwait
- Ukraine

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

Confirmed animal cases

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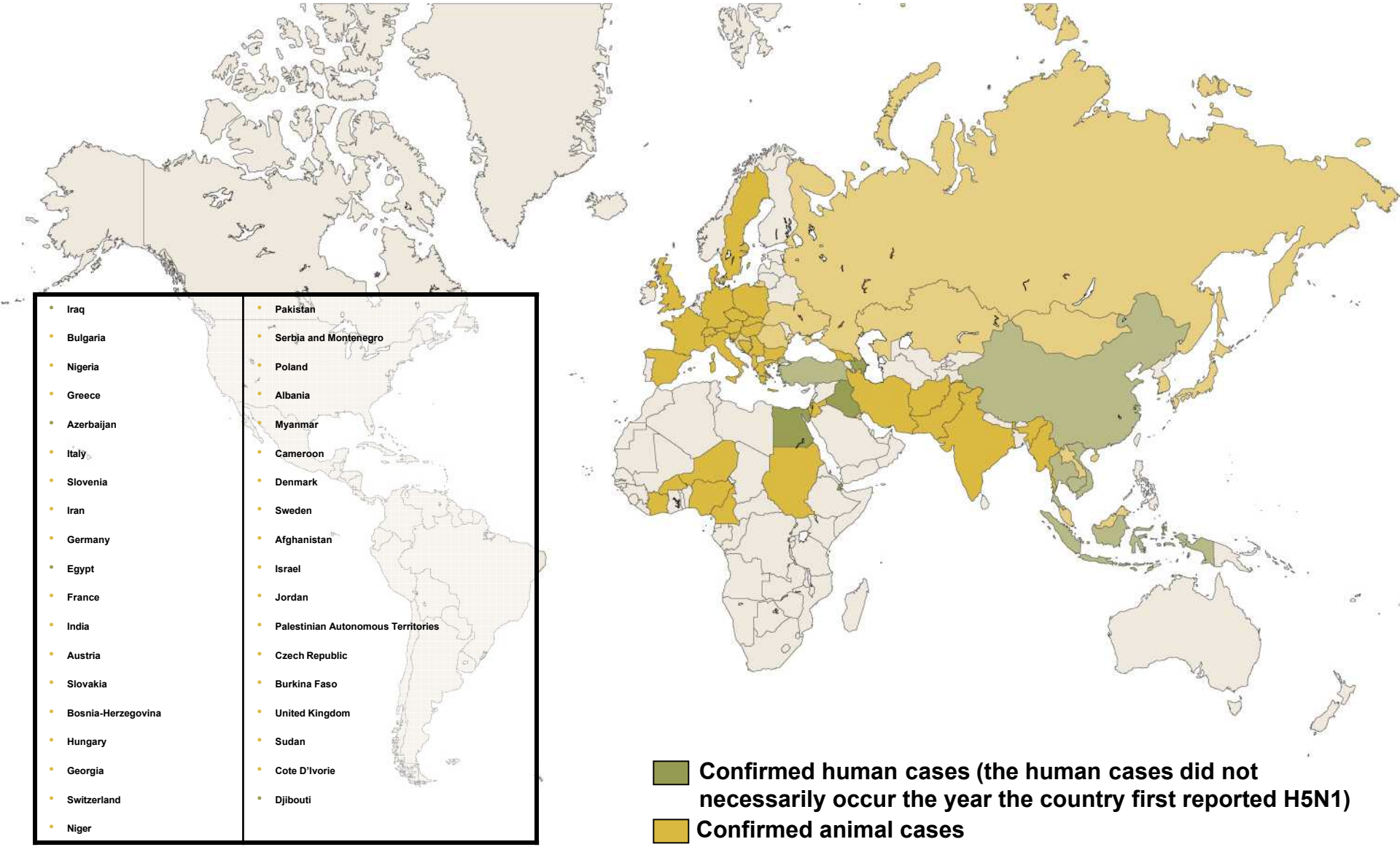
Highly Pathogenic Avian Influenza H5N1—2006



- Iraq
- Bulgaria
- Nigeria
- Greece
- Azerbaijan
- Italy
- Slovenia
- Iran
- Germany
- Egypt
- France
- India
- Austria
- Slovakia
- Bosnia-Herzegovina
- Hungary
- Georgia
- Switzerland
- Niger
- Pakistan
- Serbia and Montenegro
- Poland
- Albania
- Myanmar
- Cameroon
- Denmark
- Sweden
- Afghanistan
- Israel
- Jordan
- Palestinian Autonomous Territories
- Czech Republic
- Burkina Faso
- United Kingdom
- Sudan
- Cote D'Ivorie
- Djibouti

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

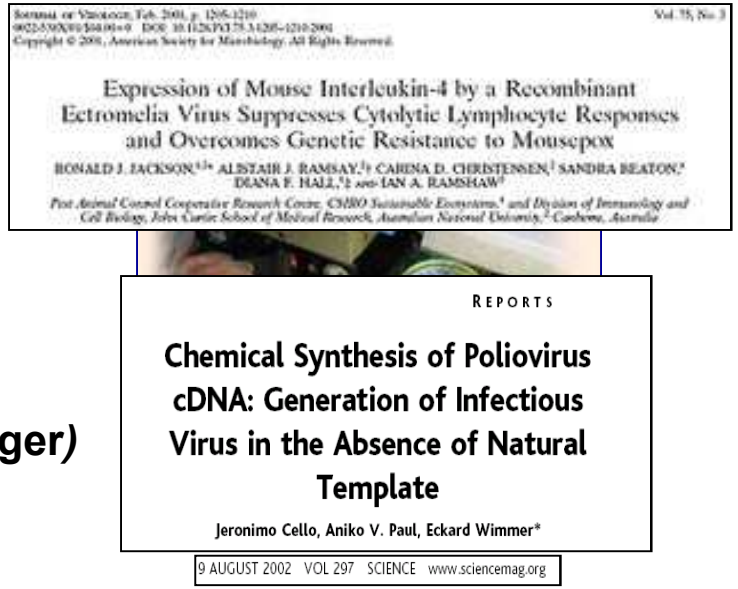
Confirmed animal cases

Biotechnology and the Life Sciences

- Rapid expansion of bioscience worldwide is perhaps the most significant influence on the biological threat
- Viable and virulent organisms are stored and used in more legitimate bioscience facilities across the globe than ever before
- Individuals with the expertise necessary to misuse biology can be found in nearly all areas of the life sciences internationally
- The tools necessary to develop and disseminate a low-grade biological weapon are ubiquitous

Double-Edge Sword of Biotechnology

- Genetic modification
  - 2001 – IL-4 and mousepox (Australia)
  - 2003 – IL-4 and mousepox (St. Louis)
- Chemical synthesis
  - 2002 – polio virus (Stony Brook)
  - 2003 – phi-X174 virus (Venter)
  - 2005 – 1918 influenza virus (Taubenberger)



Expression of Mouse Interleukin-4 by a Recombinant Ectromelia Virus Suppresses Cytolytic Lymphocyte Responses and Overcomes Genetic Resistance to Mousepox

REPORTS

Chemical Synthesis of Poliovirus cDNA: Generation of Infectious Virus in the Absence of Natural Template

Jeronimo Cello, Aniko V. Paul, Eckard Wimmer*

9 AUGUST 2002 VOL 297 SCIENCE www.sciencemag.org

- Advance of biotechnology will ease
  - Acquisition barriers
  - Production barriers
  - Dissemination barriers

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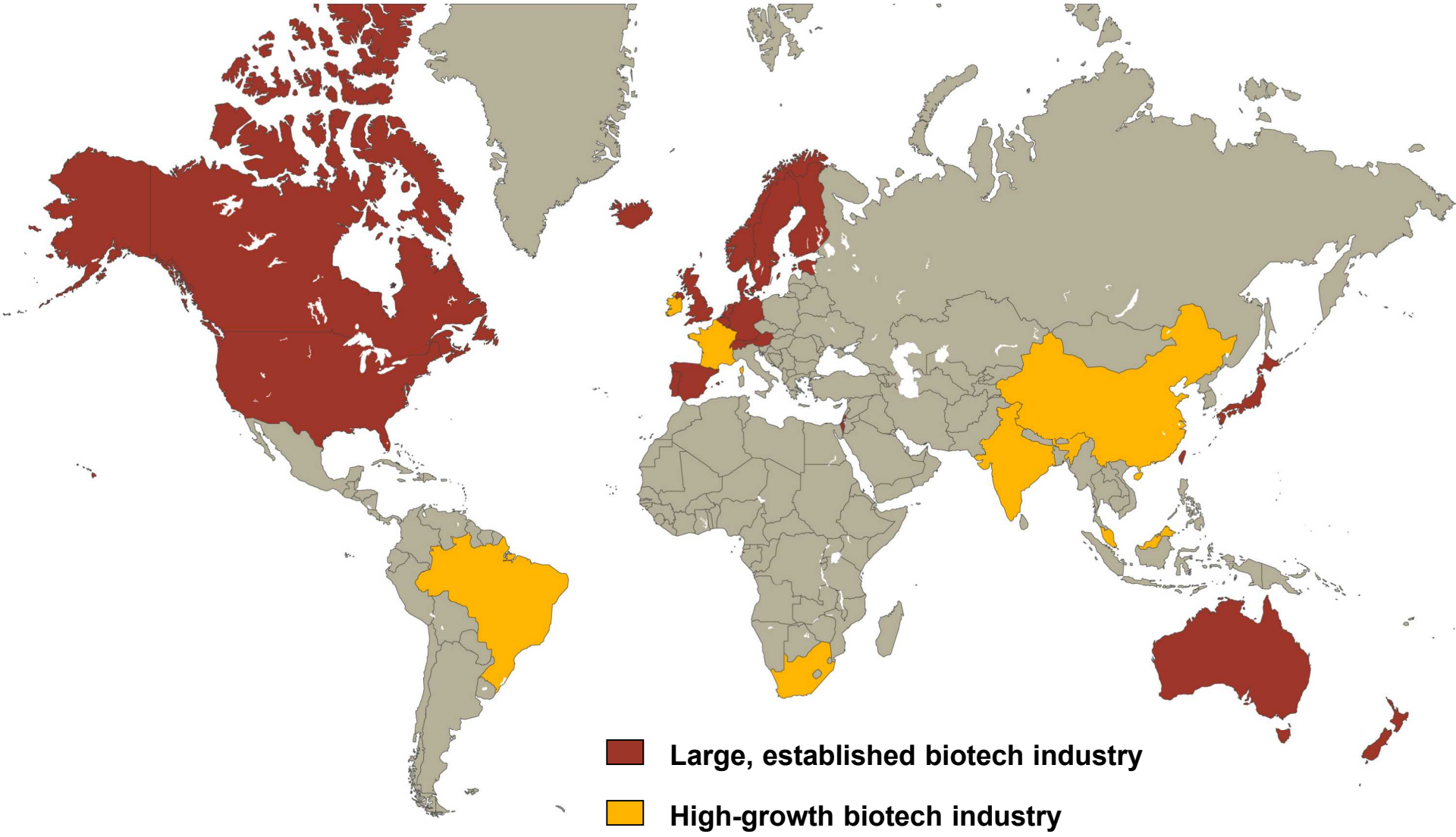
Large Biotechnology Industry and Clusters of Expertise, 2004-2005

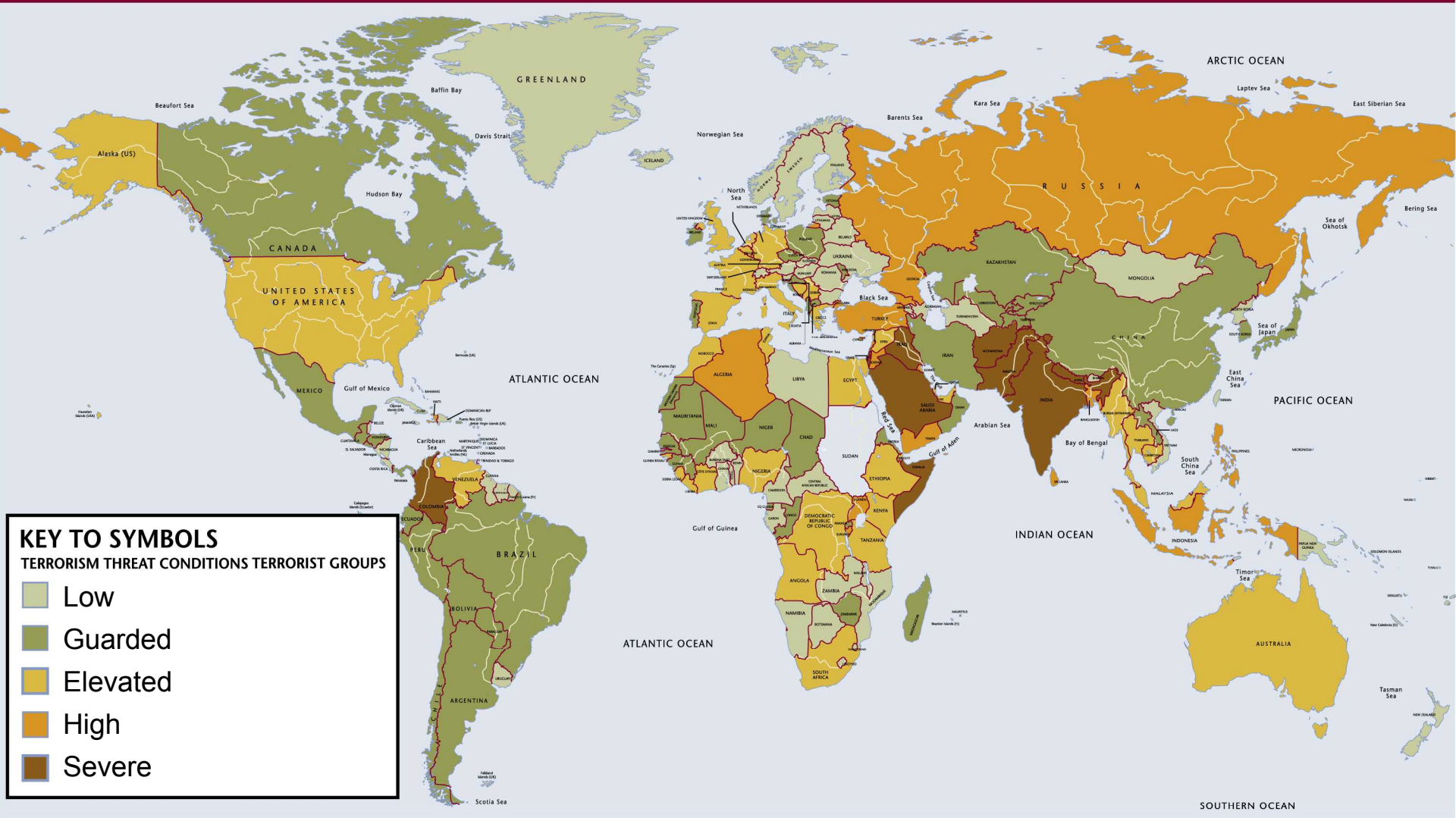


http://mbbnet.umn.edu/scmap/biotechmap.html

Transnational Terrorism

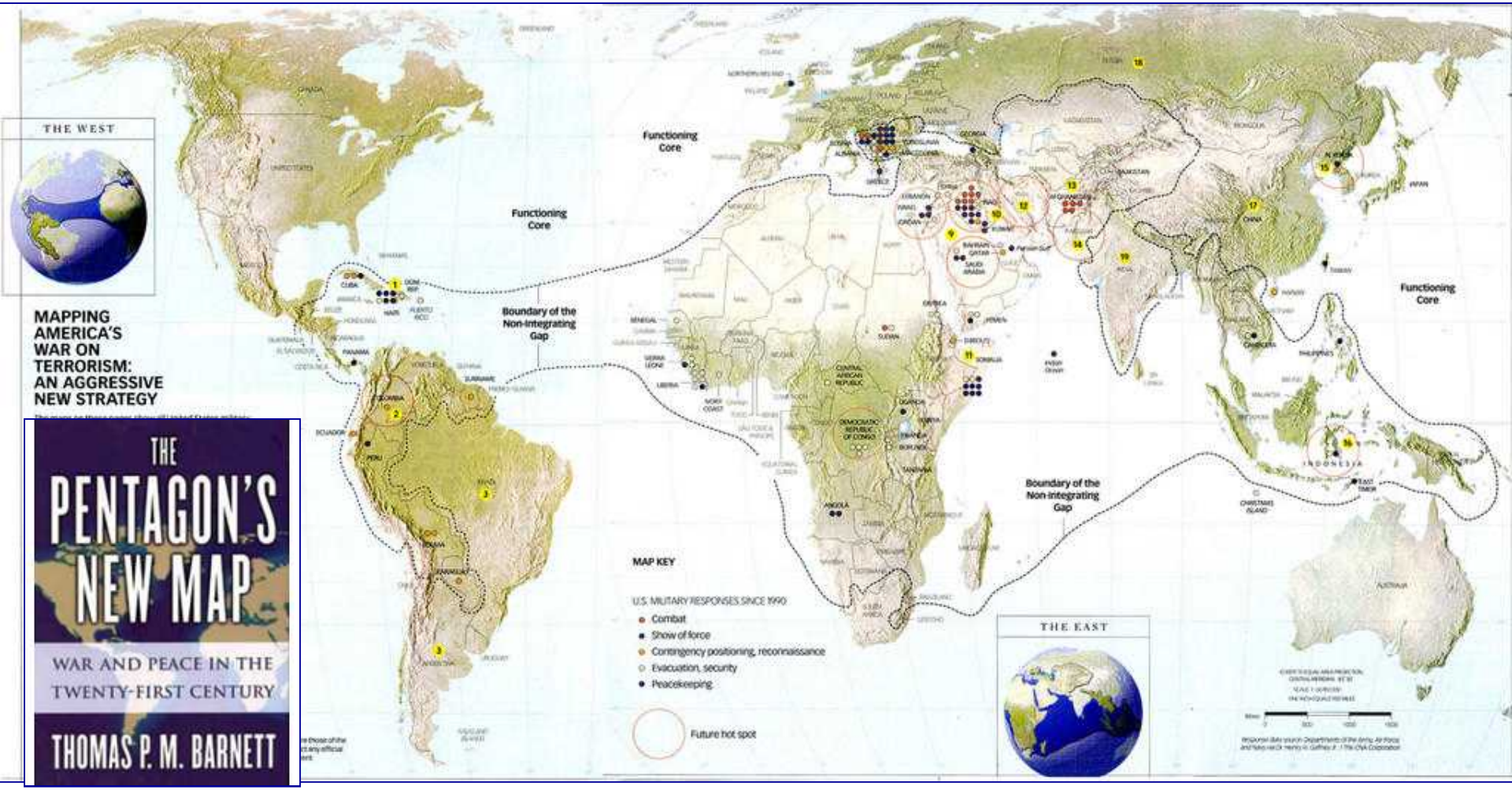
- Well financed and sophisticated terrorism has risen sharply over the last 15-20 years
- Terrorists engage in asymmetric warfare – employing unconventional tactics which experts believe will increasingly focus on acquiring and using WMD
- Terrorists are active in regions with expanding biotechnology and outbreaks of infectious disease
- Al Qaeda has repeatedly expressed interest in biological weapons
  - Osama bin Laden (1998): acquiring WMD is a "religious duty"
  - December 2001: cache of technical books, journal papers, rudimentary equipment found at abandoned training camp near Kandahar
  - September 2006: call for scientists to use bio and dirty bombs against the US

Global Terrorism Risk



http://www.aon.com/risk_management/terrorism_mitigation/terrorism_risk_map.jsp

"The Pentagon's New Map"



http://www.federalreview.com/uploaded_images/pentagons_new_map-767771.jpg

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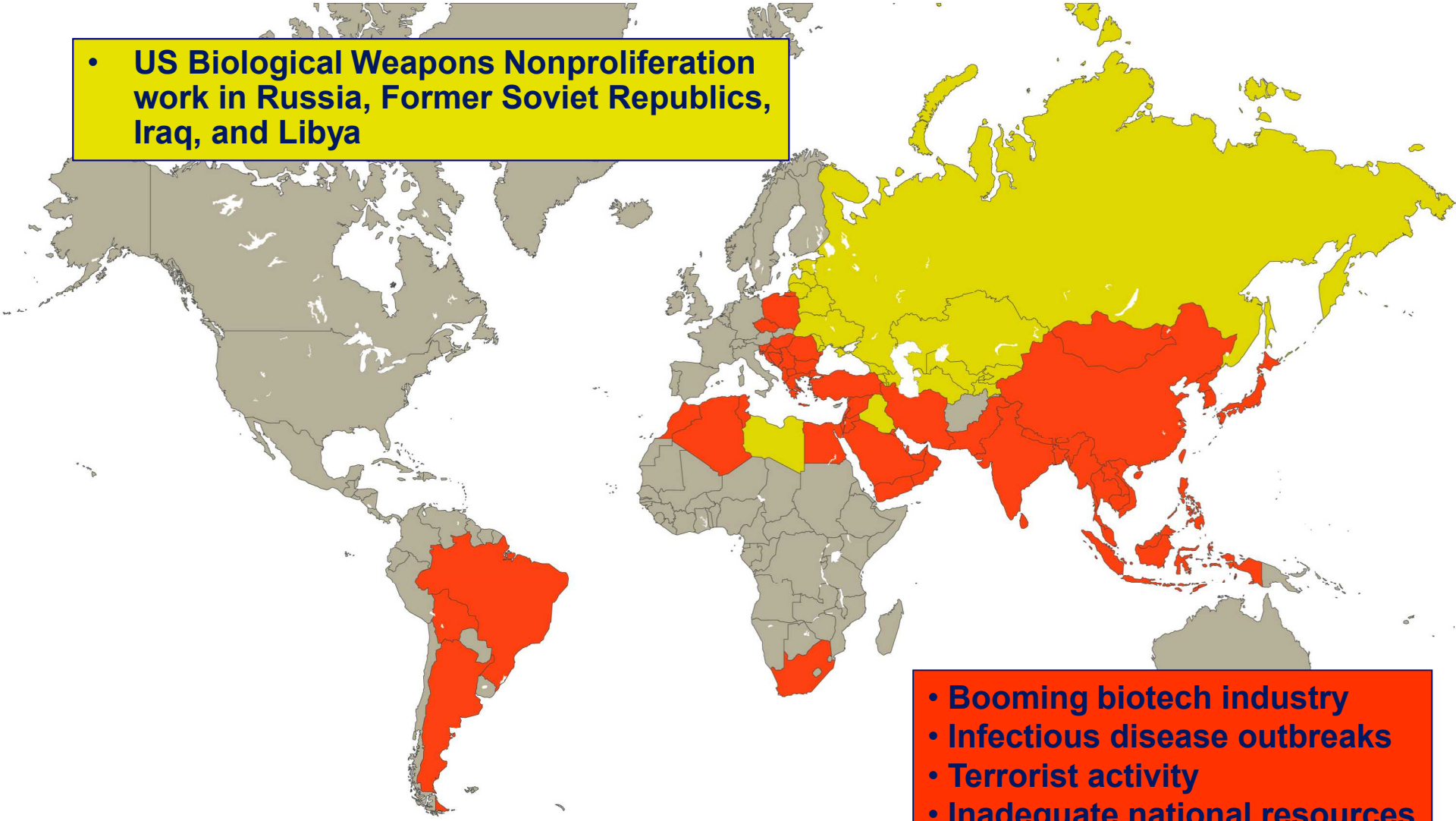
Current US International BWNP Efforts

- US Biological Weapons Nonproliferation work in Russia, Former Soviet Republics, Iraq, and Libya

Sandia Bioscience Risk Assessment

- US Biological Weapons Nonproliferation work in Russia, Former Soviet Republics, Iraq, and Libya



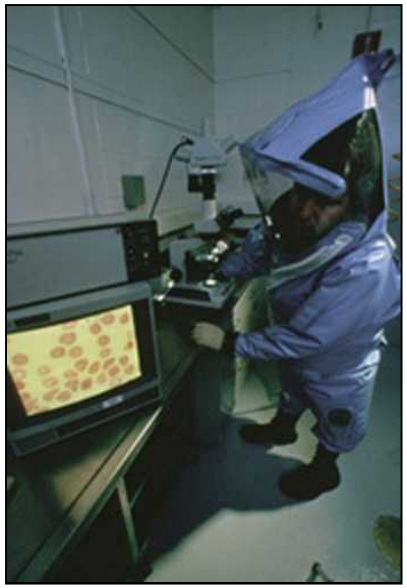
- Booming biotech industry
- Infectious disease outbreaks
- Terrorist activity
- Inadequate national resources
- Government instability

How to Prevent Bioterrorism?

- Searching for bioterrorists is a needle-in-the-haystack exercise

- Controlling biological expertise, information, equipment, and technology would stymie the advance of science and harm the fight against infectious diseases

- Limiting step for most bioterrorists is acquiring the viable and virulent pathogen
  - Dangerous pathogens are widely distributed but tend to exist in specific natural environments, facilities and transport systems



- Legitimate bioscience must continue to work with dangerous pathogens
  - Protecting legitimate bioscience globally is a critical prevention measure to reduce the bioterrorist threat

New Department of State Program in 2006

- DOS Biosecurity Engagement Program concerned about terrorists exploiting legitimate bioscience to pursue bioterrorism
  - Not looking for state-based offensive weapons programs, weapons caches, or terrorists developing weapons
- DOS working with legitimate bioscientists and law enforcement officials around the world to
  - Ensure safe and secure use of dangerous biological agents
  - Strengthen capacities to detect and control infectious disease
- Method: build relationships, share technical expertise, and promote good practices and ethical bioscience

New Department of State Global Program (www.bepstate.net)

US national security interest to help international community manage dangerous pathogens and control infectious disease

Summary

- Biological weapons (and bioterrorism) are not new
- The biological threat has evolved in concert with
  - Increasing emergence and reemergence of highly infectious disease
  - Advance of biotechnology globally
  - Rise of transnational, asymmetric terrorism
- Evolution of the threat is eliminating the traditional boundaries between security and the life sciences
- Addressing the threat will require a multidisciplinary approach that focuses on helping the international bioscience community protect itself