BROKEN SCREENS

The Regulation of Live Animal Imports in the United States

DEFENDERS OF WILDLIFE

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Defenders of Wildlife is a national, nonprofit membership organization dedicated to the protection of all native wild animals and plants in their natural communities.

PROJECT CONTRIBUTORS

The Consortium for Conservation Medicine (CCM) is a collaborative institution linking Johns Hopkins Bloomberg School of Public Health, Tufts University School of Veterinary Medicine Center for Conservation Medicine, The University of Pittsburgh Graduate School of Public Health, the University of Wisconsin-Madison Nelson Institute for Environmental Studies, the U.S. Geological Society National Wildlife Health Center and the Wildlife Trust. CCM strives to understand the links among human changes to the environment, the health of all species including humans, and the conservation of biodiversity.
www.conservationmedicine.org

The Invasive Species Specialist Group (ISSG) is part of the Species Survival Commission of The World Conservation Union (IUCN). The ISSG consist of about 150 scientific and policy experts on invasive species from more than 40 countries. The ISSG aims to reduce threats to natural ecosystems and the native species they contain by increasing awareness of invasive alien species, and of ways to prevent, control or eradicate them.
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This full report, a summary of its highlights, supplemental white papers and other supporting information are available online.
www.defenders.org/animalimports

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INTRODUCTION AND SUMMARY

RISKY BUSINESS: LIVE ANIMAL IMPORTS AND LAX LAWS

Since the United States was first settled, people have freely imported foreign animals and released them into our lands and waters or inadvertently let them escape into the wild from confinement. Some of these introduced species have caused serious environmental, health and economic problems. For example, the European starling displaced native songbirds from nest sites and damaged grain crops, and the Indian mongoose drove rare native animals toward extinction in Hawaii. In more recent news, the voracious Chinese snakehead is changing the fish populations of the Potomac River, and huge pet Burmese pythons dumped in Everglades National Park by their owners are competing with and attacking the park's native wildlife. Harmful introduced species such as these and the inadequacies in the system in place to regulate them are the focus of this report.

The cumulative control and management costs of ridding our public and private lands of non-native, invasive, "pest" animals have never been compiled, but are no doubt very high. In addition, infectious pathogens and harmful parasites have also accompanied many animal imports. The names alone of the diseases carried into the United States via this pathway during the past few decades are frightening: exotic Newcastle's disease, heartwater, malignant catarrhal fever, monkeypox, rabbit viral hemorrhagic disease, chytridiomycosis and ranavirus.

Inadequate Regulation

Despite our bad experiences with introduced species, the annual volume of live animal imports in the United States has roughly doubled since 1991. Several authoritative reports have described the federal regulatory system applied to these imports as outdated and ineffective in view of the massive trade volume. Experts say that the ongoing non-native animal invasions and disease outbreaks in this country are not inevitable; many could be prevented, especially if the initial entry of risky species was blocked at or before our borders.

However, our own lax laws prevent us from doing this more comprehensively and are often so weakly implemented as to seem nonexistent. Consider this excerpt from an Associated Press report of an exchange between a Centers for Disease Control and Prevention (CDC) investigator and the Ghanaian animal exporter responsible for the shipment of Gambian rats that brought the highly contagious monkeypox virus to the United States in 2003:

Before the CDC team left Ghana, the exporter told [CDC investigator Darin] Carroll that Europe uses strict quarantines to catch diseased wildlife imports, making it expensive for both the exporter and importer. "That's why he loved to send animals to the United States, because he said there are no rules," Carroll said. [1]

There is, in fact, a variety of rules governing live animal imports and several agencies charged with enforcing them. But as this report demonstrates, this complex federal system resembles a set of broken "screens" and keeps out almost nothing but the most glaring threats. The federal government could readily mend these screens because the shipping ports, airports and border crossings where these intentional, legal, animal imports arrive are but a few dozen in number. Indeed, compared to the other major pathways for harmful species introductions into the United States, intentional animal imports are the easiest to regulate effectively if Congress and the administration choose to do so. Trying to regulate invasion pathways such as ship ballast water contaminated with microscopic organisms, imported nursery plants bearing hidden pests and pathogens, containers and wood packaging with "hitch-hiking" insects inside, and human travelers carrying new pathogens into the country is also important, but poses far greater technical and practical obstacles.

In the pages that follow Defenders of Wildlife covers all intentionally and legally imported wild animal taxa and considers all categories of harm potentially caused by this trade in the United States: environmental disruption, economic harm and threats to human and animal health. This report does

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not consider domesticated animals, animal parts or products, humane issues, or harms caused in the exporting countries. The main focus is federal policy. Due to the supremacy of federal laws governing both international and interstate commerce under the U.S. Constitution, art. 1, sec. 4, the states are relatively powerless to impose a "tighter screen" against importation of a species initially allowed into the country by a federal agency. Further, even if it has stricter laws on the books, no mainland state staffs ports with inspectors to enforce such laws against federally allowed imports. And any one state can do very little to protect itself from a species introduced initially in another state. Except for Hawaii and perhaps Alaska, it is almost impossible for a state to police interstate commerce—or the massive, noncommercial, private transportation of animals—after a potentially harmful animal species is allowed anywhere inside the nation's borders. In short, policing the importation and interstate movement of non-native animals is a distinctly federal function.

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An alligator (left) ingests a pet Burmese python released in Florida's Everglades National Park. A Gambian rat (above) imported for the pet trade carried the highly contagious monkeypox virus from Africa to the United States in 2003.

Groundbreaking Analysis

This report breaks new ground because Defenders has obtained, and is making public for the first time, complete listings of all the 2,241 identified non-native species in the wild animal import trade, according to U.S. Fish and Wildlife Service data for the period from 2000 through 2004. In coordination with the Consortium on Conservation Medicine (CCM), and with input from scientists worldwide, Defenders preliminarily evaluated (or "coarsely screened") the invasion and disease risks presented by these species. This included an innovative project for which Defenders contracted with scientists from the World Conservation Union (IUCN) Species Survival Commission's Invasive Species Specialist Group (ISSG) to compare the U.S. animal import list with international lists of invasive species generated from the ISSG's Global Invasive Species Database, its incipient Global Registry of Invasive Species and many other international sources. This was a significant effort because the whole of the U.S. import list has never before been compared to international invasive species lists even though, according to invasive species experts, the single best predictor of invasiveness of a non-native species in a given location is if it already has invaded somewhere else.[2]

Defenders makes the case here that conducting a similar global database search should be considered a standard regulatory tool to screen for and identify potentially risky animals. This rudimentary precaution—to check first and see if a species appears on global lists of known "bad actors" *before* allowing it to be imported and sold in the United States—will help federal agencies better regulate proposed non-native animal imports.

Defenders' coarse-meshed screening for the 2,241 identified imports, explained in detail herein, relied on readily accessible scientific and regulatory information, as well as expert opinion. This screening, which took about four months and cost less than $30,000 in staff time and expenses, points the way to what, at the bare minimum, the federal government can and should do in the future.

Several federal agencies have scattered authority over live, intentionally imported animals. Generally, the U.S. Department of Agriculture covers imports that pose risks to livestock and plants, the CDC covers human disease vectors and the U.S. Fish and Wildlife Service, operating under the outdated Lacey Act, which was enacted in 1900, covers a small number of species it has listed as "injurious," mostly birds and mammals. The system is almost entirely reactive. With limited exceptions, it is not implemented to screen proactively and to prevent new invasions and disease outbreaks. The Lacey Act injurious species listing system is mired in cumbersome regulatory procedures, which typically can take **four years** to prohibit **one** non-native species. This report will show that, like trying to keep mosquitoes out of a house with torn and broken screens, this system does not work.

Chapter 1 comprehensively describes the live animal import trade, the identities of the imported species and the results of the coarse-mesh risk screening. (Appendix B lists the names of, and information about, all 302 risky species highlighted in that screening process.) Chapter 2 covers the types of environmental impacts inflicted on native species and North American

ecosystems by alien invasive animals* and discusses how global warming magnifies the risks of invasions. Chapter 3, contributed by disease experts at CCM, lays out the human and animal health risks. This CCM contribution is the most focused examination to date of the connection between emerging infectious diseases and the live animal trade. Chapter 4 describes the existing federal regulatory system and assesses its effectiveness in screening out potentially harmful imports, including the risky species revealed in this report. (Appendix C, which complements Chapter 4, provides summaries of the convoluted regulations that agencies have issued under the current statutory system.)

Chapter 5 concludes the report with federal policy recommendations for reducing the environmental, economic and health risks to much more tolerable levels. Not all risk can be eliminated, of course, but given the huge and continuing increases in international trade coming into this country, no excuse exists to follow a weak, fragmented, federal regulatory system dating back to the early 1900s. Our shockingly inadequate statutes and regulations desperately need modernizing, and the animal import industry and other stakeholders must be constructively engaged in the necessary reforms. Chapter 5 tells how, working together, we can mend our broken screens and keep harmful species out of the United States.

One final preliminary note: This report's focus on non-native animal imports into the country is not meant to discount the fact that the ongoing foreign imports of U.S.-native species, as well as translocations within the country of both U.S-native and non-native species, also can present invasive species and disease risks. To keep the report manageable in size these other types of animal movements are not addressed. Moreover, while Defenders also recognizes the significant conservation impacts and humane concerns from overexploitation of wild-caught animals in the *exporting* countries, the scope of this report is necessarily limited to risks from this trade to the *importing* country, the United States.

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A snakehead is readied for sale at an Asian fish market. These aggressive fish, imported live to the United States by the aquarium and specialty food trades, are turning up in American streams and rivers to the detriment of native fishes and aquatic ecosystems.

ADDITIONAL READING

Understanding the international context for the recommendations in this report is vital to ensuring that Congress and the agencies, as they seek to reform U.S. law, do not violate international trade laws to which the United States is a party. Defenders addresses these trade laws and related issues in a white paper, *International Law on Precautionary Approaches to National Regulation of Live Animal Imports*. Understanding the economic impact invasive species have is also important. Defenders' team of natural resource economists examine those impacts and how to account for them in another white paper, *Economic Impacts of Live Animal Imports into the United States.*

To access these white papers–and complete alphabetized lists of all identified imported species and other background information–see Appendix A or go directly to Defenders' companion Web page, www.defenders.org/animalimports. The Web page is a regularly updated resource on the issue of U.S. animal imports. This report and a summary of its highlights are also available for downloading there.

* Confusion over definitions and terminology sometimes confounds policy discussions about non-native species and whether they are invasive. For the purposes of this report, "invasive species" is defined as stated in President Clinton's 1999 Executive Order (EO) Number 13112 on Invasive Species, which is recognized by most federal agencies (see www.archives.gov/federal-register/executive-orders/1999.html). The EO defines the term as: "*an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.*" An "*alien species*," which is equivalent to the term "non-native" used herein, is defined in the EO as: "*with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.*" As this report applies to the entire country, the "ecosystem" focused on here consists of the 50 states, the District of Columbia and their associated waters.

CHAPTER ONE

IDENTIFYING, QUANTIFYING AND SCREENING

The majority of live, wild animal imports are for the pet and aquarium industries, but other commercial, recreational, educational and scientific entities such as game ranches, food distributors, public and private zoos and biomedical research labs are also involved. As the leading import market in this global trade, the United States receives hundreds of millions of animals each year. Shipments entering this country are primarily for domestic markets, although the United States also is a major "re-exporter" of imported animals to other countries. In addition, native U.S. species are frequently exported. In 2003, for example, the United States exported more than 20 million live animals, most commonly native red-eared slider turtles for the pet trade.[3] However, "re-exports" and exports of native species are outside of the scope covered here.

This report draws primarily on data for the *legal intentional* trade in live animals imported into the United States. The *illegal* trade in live animals is, of course, far more challenging to quantify. Illegally traded animals are typically high-value prohibited species, such as rare parrots or exotic animals intended for illicit food markets, smuggled in relatively small numbers compared to the legal imports. Neither these illegal imports, including animal parts and products, nor *unintentional* imports in the form of live animals that may "hitchhike" on or "stowaway" in ships, planes, vehicles and imported products, are covered here.

This chapter summarizes the volume and identities of imported live animals from 2000 through 2004. It also describes the preliminary risk screening through which Defenders and its contributing experts found that more than 300 of these non-native species have prior histories of coming to the attention of scientists or regulators, in the United States or around the world, as known invaders, potential invaders and/or disease risks.

The Wild Animal Import Trade

The U.S. live animal trade has grown significantly since the 1990s, driven in part by the increasing popularity of rare pets.[4] The ease of international travel, shipping and financial transactions has made importing animals less difficult than ever. Importers have access to the latest communications technology and to overnight air-cargo services from almost anywhere in the world. The Internet allows online sellers of non-native animals to deal more directly with buyers, which circumvents pet stores and thus often avoids licensure and inspection requirements.

Legal imports of wild animals generally arrive at one of 18 designated ports of entry.[5] Between 2000 and 2004, the three highest-volume ports were New York, Los Angeles and Miami.[6] With certain restrictions, animal imports may also cross at 23 customs offices located along the Canadian border, seven offices along the Mexican border or, with special additional restrictions, three ports in Alaska, one in Puerto Rico and one in Guam.

According to regulations of the U.S. Fish and Wildlife Service (FWS), importers must declare animal shipments to FWS inspectors at the port of entry and make the animals available for visual inspection prior to taking them from the port. (For details of the legal provisions FWS administers with respect to this trade, see Chapter 4 and Appendix C.) However, the thinly stretched FWS inspector corps does not actually visually inspect each shipment. The proportion of shipments inspected varies, ranging from only roughly one-quarter of fish shipments up to about two-thirds of bird shipments.[7]

Other than specified mammals, birds and a few fish species, no other imported wild animals are required to undergo a quarantine period or to bear proof of prior veterinary clearance from their country of origin. Shipments of a vast variety of non-native species that pass the border may quickly disseminate throughout the 50 states, none of which, besides insular Hawaii, possesses the ability to exercise effective control over interstate commerce and travel. Thus, by way of illustration, a tropical snake caught in the wild in Africa could arrive at a home in Florida and then be moved by its owner to Louisiana, all in a matter of a few days. If it then somehow escapes from captivity, or is released on purpose, and it manages to survive, it could become a new wild resident of North America in short order.

Volume and Characteristics of the Trade

Defenders, via a 2005 Freedom of Information Act (FOIA) request, obtained and compiled the 2000-2004 import records of the Law Enforcement Management Information System (LEMIS) maintained by FWS, the agency responsible for monitoring almost all live, wild animal imports. Based on these data, Defenders compiled alphabetized lists of all of the live animals that were fully identified in the LEMIS data to the species level, as well as several other related and subsidiary lists (see Appendix A). (Defenders compared similar LEMIS data from this period obtained by other researchers, who used different terms in their FOIA information requests to the FWS. Some discrepancies exist among the various species lists; consequently, the lists compiled in Appendices A and B, while giving an overall portrait of the trade, should not be considered definitive.)

Imports identified by species

Table 1 provides a summary of the numbers of imported animal species by major taxonomic group for those shipments that the LEMIS data fully identified. It breaks the numbers down in each group for species that are "native" and "non-native" to the United States and for the small number

of species for which Defenders could not readily determine if their natural range included any portion of the United States.[8] **Table 1 is the first publicized compilation of this species information for the U.S. import trade.**

The regular import of animals *native* to the United States—about 17 percent of all species in Table 1—is easily explained. Many species native to the United States are also native and common in other countries. For example, white-tailed deer (*Odocoileus virginianus*) are native throughout the mainland Americas as far south as Peru. Cross-border traffic in them is unsurprising. Many native species may be imported through exchanges of specimens among zoos, wildlife parks and aquaria for a variety of reasons. Moreover, economic advantages may exist for raising U.S.-native species via captive breeding in other countries for export back to U.S. markets.

The research summarized in Table 1 revealed that the most diverse categories of non-native imports are birds and reptiles, with 559 and 710 different species, respectively. Together, they amount to 1,269 or more than half the total of 2,241 non-native species. Vertebrates make up more than four-fifths of the imported species. Yet, among invertebrates, the high number (182) of cnidarians—the phylum that includes jellyfish, corals, anemones and related species—is notable. Cnidarians likely are one of the least-studied of animal groups. For 19 (8 percent) of imported cnidarians, not enough information was available even to determine if their native ranges include U.S. waters.

Table 1 does not cover the huge number of imported animal shipments for which the LEMIS data provided in response to Defenders' FOIA request did not give the species' full scientific names. These animals, hereafter called "unidentified species," were identified in those data only to the class, order, family or genus level, or were labeled only vaguely, e.g., "tropical fish" or "non-CITES fish." Under FWS regulations every imported species should have been fully identified on the import declaration forms that accompanied the shipments; however, those original forms were not publicly available.[9] Due to time and personnel constraints, FWS does not enter every species name in the LEMIS data it prepares based on those forms.

Table 2 breaks the import numbers down

Table 1. Numbers and Natural Ranges of Species-Identified Animals Imported to the United States, 2000-2004

Taxonomic Group	Total Species Imported	Non-native Species Imported	Proportion of Non-native Species	Native Species Imported	Proportion of Native Species	Indeterminable Natural Range in U.S.*
VERTEBRATE						
Amphibians	195	172	88%	23	12%	0
Birds	653	559	86%	94	14%	0
Fish	192	121	63%	66	34%	5 (3%)
Mammals	308	263	85%	45	15%	0
Reptiles	799	710	89%	89	11%	0
Vertebrate Totals	**2,147**	**1,825**	**85%**	**317**	**15%**	**5 (0.2%)**
INVERTEBRATE						
Annelids	5	3	60%	2	40%	0
Arachnids	96	92	96%	3	3%	1 (1%)
Cnidarians	262	182	69%	61	23%	19 (8%)
Crustaceans	41	23	56%	14	35%	4 (7%)
Insects	69	60	87%	9	13%	0
Molluscs	75	41	55%	30	40%	4 (5%)
Porifera	4	3	75%	1	25%	0
Other	27	12	44%	13	49%	2 (7%)
Invertebrate Totals	**579**	**416**	**72%**	**133**	**23%**	**30 (5%)**
GRAND TOTAL	**2,726**	**2,241**	**82%**	**450**	**17%**	**35 (1%)**

Source: 2000-2004 FWS LEMIS data

* "Natural range in U.S." means that any portion of a species' known natural range includes any portion of the 50 states or associated waters. Thus, "non-native" as used here means not native anywhere in the nation. For this coarse screening process, ranges were determined by consulting standard field guides, online scientific databases and other sources for each of the 2,726 identified species. Note also, as discussed in the text, that a large but indeterminable number of additional species were imported for which species-level identification was unavailable from the LEMIS data.

Table 2. Quantities of Live Imported Animals Identified and Unidentified to Species Level, 2000-2004

	Number of Individual Animals Imported			Weight of Imports (kg) (for shipments not counted individually)		
	Identified Species	Unidentified Species	Proportion Identified	Identified Species	Unidentified Species	Proportion Identified
VERTEBRATES						
Amphibians	23,780,548	2,577,619	90%	1,288,908	9,839	99%
Birds	1,470,703	693,647	68%	350	0	100%
Fish	15,218,584	876,792,759	2%	1,760,016	980,830	64%
Mammals	214,871	23,450	90%	11,833	915	93%
Reptiles	6,733,326	2,364,015	74%	0	0	-
INVERTEBRATES						
Annelids	2,294,190	9,094	99%	101,510	0	100%
Arachnids	746,910	422,840	64%	0	0	-
Cnidarians	983,983	1,988,055	33%	139,804	106,044	57%
Crustaceans	10,504,429	117,443,164	8%	551,047	71,022	89%
Insects	57,400	3,164,021	2%	933	161	85%
Mollusks	1,808,791	4,364,258	29%	119,299	42,938	74%
Porifera	29,005	39,261	42%	224	520	30%
Other	13,353	58,460	19%	112	341	25%
TOTALS						
All Taxa	**63,856,093**	**1,009,940,642**	**6%**	**3,974,035 kg**	**1,212,609 kg**	**77%**
All Taxa Excluding Fish	**48,637,509**	**133,147,883**	**27%**	**2,214,019 kg**	**231,779 kg**	**91%**

Source: 2000-2004 FWS LEMIS data

differently than Table 1, showing within each taxonomic group the quantities of animals that were "identified" and "unidentified" in the LEMIS data. It divides these animals into two major categories: imported animals that were counted *individually* and separate shipments of animals that were quantified only by *weight* rather than number of individual animals.[10]

Remarkably, the LEMIS data provided to Defenders and presented in Table 2 fully identified only 6 percent of individually counted animals down to the species level. It is also notable that the fish category alone constituted the vast majority of imported organisms, with more than 850 million individuals. While the ultimate intended use of these fish is uncertain, most were likely tropical fish for home aquaria. Only 2 percent of the individually counted imported fish and insects were identified down to the species level. Similarly, for the cnidarians, crustaceans, porifera (sponges), mollusks and other groups, less than 50 percent of the individually-counted imports were identified in the LEMIS data. The massive quantities of unidentified imports in the FOIA records provided to Defenders present potential invasion and/or disease risks that largely escape scrutiny in this report. Without a species name to tie to animal shipments, reliable assessments of their significance cannot be made.

It is not possible to determine precisely how many different species the unidentified shipments represent. However, a metric

A CONSERVATIVE ESTIMATE

Many shipments of animals were not even identified down to their genus names in the 2000-2004 LEMIS data. i.e., they were identified only by class, family or vague labels such as "non-CITES fish." In addition, of course, an indeterminate number of novel species of animals have been imported since 2004 and are not represented in the data. In short, the totals of known species that Defenders presents in this report are conservative and incomplete as far as giving a full picture of the live, wild animal import trade.

does exist for the animals that the LEMIS data identified by genus only, indicating that probably at least 433 more unidentified species were imported in addition to the 2,726 total identified imported species reported in Table 1.

Species identified based on "novel genera"

Table 3 indicates the estimated minimum number of additional species based on "novel genera" represented in the imported animal shipments documented in the public LEMIS records. "Novel genera" here means the genus name does not duplicate any genus name in the 2,726 fully identified species tabulated in Table 2. Thus, none of the species represented by their genus names in Table 3 could represent any of the species already included in Table 1. Indeed, these "genus-only" records could cumulatively represent many more than the estimated minimum total of 433 more species, depending on whether more than one species in a given genus was imported with genus-only identification. Within these estimated 433 additional species, it is not feasible to state with certainty how many are native and non-native in the United States, as many of the genera could contain both U.S.-native and non-native species.

Table 3. Estimated Number of Additional Species Imported Based on Genus-only Identification Records

Taxonomic group	Estimated additional species with genus-only records
Amphibians	15
Birds	51
Fish	104
Mammals	24
Reptiles	47
Annelids	3
Arachnids	25
Cnidarians	44
Crustaceans	27
Insects	34
Molluscs	44
All other groups	15
TOTAL	**433 species**

Source: 2000-2004 FWS LEMIS data

Quantifying legal imports

Table 4 summarizes what is known from the LEMIS records in terms of quantity of all legal imports (native plus non-native species) and their declared value. More than one billion individually counted animals plus over five million kilograms of animals by weight were imported during the five-year period. Their cumulative declared wholesale value at the ports of entry exceeded $500 million. As these large import quantities may be difficult to grasp, Table 5 breaks them down to yearly and daily averages. Thus, on a typical day the United States imported a remarkable 588,000 individually counted animals plus an additional 3 tons of animals that were weighed, not counted individually.

Figures 1 and 2 (opposite) show the major source countries for those imports quantified in the LEMIS database by numbers of individuals and by weight, respectively. (Appendix A, Item 8, provides a list of all the source countries.) The total of 163 sources represents 85 percent of the 192 countries recognized by the United Nations. These countries represent the vast bulk of the Earth's land surface and associated waters except Antarctica. In short, almost all of the planet's fauna is potentially within reach of being captured and shipped to the United States. The greatest concentrations of source countries lie in North America itself (Canada, Mexico and the Caribbean), Southeast Asia and the northerly countries of South America. Sources such as Singapore, Canada, Hong Kong and Taiwan likely are not the actual countries of native origin of many shipped animals. Rather, they may be re-exporting animals—mostly tropical fish—collected or harvested elsewhere.

Again, assessing the full significance of the impacts in the countries of origin from the extensive harvests that supply U.S. importers with nearly 600,000 individual animals and three additional tons of imports on a typical day lies beyond the scope of this report.

Table 4. Summary of Live Animal Import Data by Number, Weight and Value, 2000-2004

Total Individually-counted animals	1,073,796,735
Average Annual Total of Individually- counted Animals (over 5 years)	214,759,347
Total Weight, for Animals Imported by Weight	5,186,644 kg
Average Annual Weight, for Animals Imported by Weight	1,037,329 kg
Total Value of Imported Animals, Declared Wholesale	$546,884,559
Average Annual Declared Value	$109,376,912

Source: 2000-2004 FWS LEMIS data

Table 5. Yearly and Daily Averages of Live Animal Imports, 2000-2004

Total Imports	1,073,796,735 individually counted animals over 5 years
or	214,759,347 animals per year, average
or	588,000 animals per day
PLUS	5,186,644 total kg of uncounted animal imports over 5 years
or	1,037,329 kg per year, average
or	2,842 kg per day
or	> 3 tons (U.S.) per day

Source: 2000-2004 FWS LEMIS data and Table 4

Fig. 1. Top 25 Sources for Individually Counted Animals

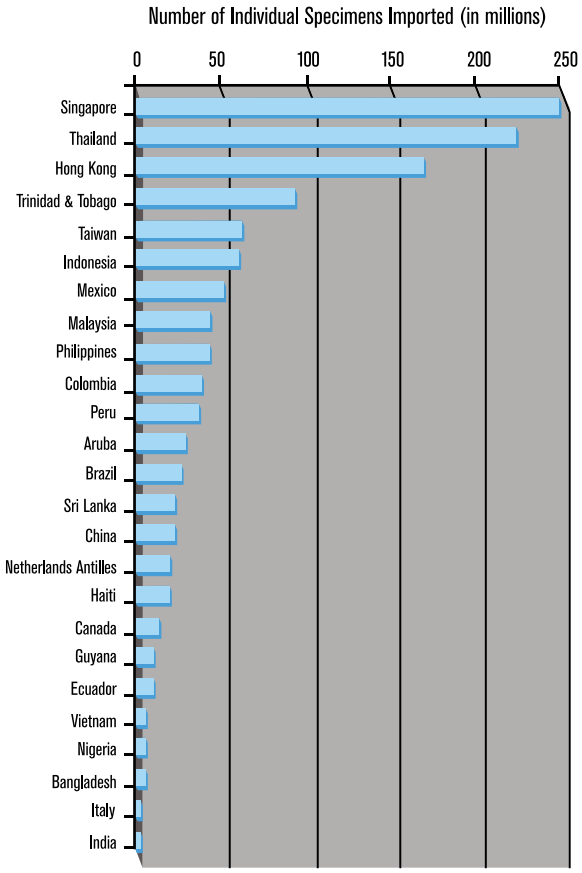
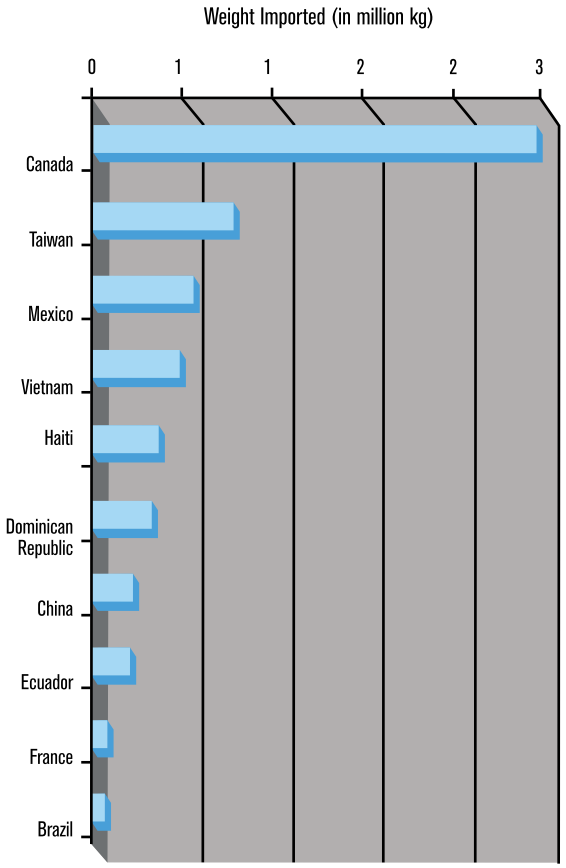


Fig. 2. Top 10 Sources for Animals Imported by Weight



Captive-bred Non-native Species

Not all live non-native animals shipped and purchased in the United States are imported. Many species are now captive-bred from imported ancestor stock in commercial enterprises by aquaculturists, pet breeders and live-bait producers or noncommercially by hobbyists, and would not necessarily appear on FWS import lists. No comprehensive lists exist of all the non-native species being captive-bred in the United States. Nor do any federal regulations mandate or facilitate collection of these data. Many breeders are small-scale or "backyard" family enterprises that may last just a few years.

Thus, the data gathered for this report on imported non-native species are not exhaustive or indicative of the total numbers of such species present in the United States. Any future risk-screening or related regulatory programs should not ignore U.S. captive-bred populations because they may present the same risks as imported stock. Indeed, U.S. captive-bred animals could present higher or lower risks than their imported cousins, depending on the species and the circumstances involved.

Preliminary Risk Screening

With all the limitations to the available data as discussed above, Defenders nevertheless uncovered a wealth of new information not only on the identities of the 2,241 non-native imported animals but also on the risks that a subset of them present. Defenders conducted a "coarse-meshed risk screening" by reviewing a wide number of primarily U.S. information sources. The basic criterion for a species being "risk annotated" was the existence of a reliable scientific source indicating that the species was known or predicted to be invasive or harmful anywhere in the world. These sources were readily available in published literature and in dependable, mostly federal and state, online databases. Defenders also canvassed recognized invasive species experts for additional information source suggestions.

Defenders also contracted with scientists from the World Conservation Union (IUCN) Invasive Species Specialist Group (ISSG) to compare the U.S. animal import list with international lists of known invasive species. These lists were generated through the ISSG's new Global Registry of Invasive Species (GRIS), its Global Invasive Species Database and other international sources. (See "The Screening Process" on page 12 for more details on the research conducted.)

While Defenders' sources point to invasive, potentially invasive, and/or disease risk outcomes for 190 species of the 2,241 non-native species on the LEMIS list, the international sources cited by ISSG point to an additional 117 species (i.e., 191 minus the

74 species in common) that could pose risks in the United States based on their records of invasiveness or potential invasiveness elsewhere. Thus, the combined total was 307 risk-annotated species. Corrections to the non-native species list after the ISSG report was issued reduced that total to 302 species, or 13 percent of all imported non-native species. (See Appendix B for the complete list of risk-annotated species and sources.)

The screening conducted for this report is *not* a detailed scientific assessment of the probability that a given annotated species could survive and/or cause damage in the United States. That is why the screening is "coarse-meshed." In view of the 2,241 non-native species this effort covered, it necessarily represents a beginning rather than an end. More detailed assessments on a case-by-case basis would probably find that some of the risk-annotated species would not in reality cause any harm in the United States, whereas a wealth of additional risk documentation may exist for other species that this coarse screen did not catch.[11]

THE SCREENING PROCESS

To assess the risks posed by imported species, Defenders compared the names of the 2,241 non-native species on FWS's LEMIS import lists to several online databases of invasive or potentially harmful species and numerous scientific and regulatory sources (see Appendix B for a list of all sources). From this initial screening, Defenders' researchers identified 190 species on the LEMIS list as invasive, potentially invasive and/or as posing a disease risk.

The IUCN's Invasive Species Specialist Group (ISSG) separately screened the same original list of 2,241 imported species. The ISSG manages the Global Registry of Invasive Species (GRIS). This searchable database compiles and integrates lists of species names with data from multiple sources on occurrence, native/alien status and invasiveness and impacts in locations worldwide and generates annotated reports for each species (see Appendix A, Item 6).

With limited funds and time, the scope of the ISSG research was narrowed to searches on harmful or potentially harmful species in 16 countries: Australia, Canada, China, France, Indonesia, Mexico, New Zealand, Philippines, Russia, Singapore, South Africa, Taiwan, Thailand, Trinidad and Tobago, United Kingdom and Vietnam. Defenders chose these countries because they are either leading sources of U.S. animal imports or are known to have accessible data on invasive species. Based on records from the GRIS, the ISSG Global Invasive Species Database and other readily available and authoritative scientific sources listing potentially invasive or harmful animals, ISSG researchers identified 191 species that were invasive and/or potentially invasive.

Defenders' list of 190 annotated species then was compared with the ISSG's list of 191 species that were invasive and/or potentially invasive. Only 74 species overlapped on the two lists, a fact that may be explained by the different scopes of the two efforts. The ISSG focused on a selection of non-U.S. sources on invasiveness in 16 countries, while Defenders tapped mostly internal sources in the United States, including extensive U.S. disease risk data. The combined research by Defenders and the ISSG for this entire coarse screening process for more than 2,200 species took about four months and cost less than $30,000 in staff time and expenses. A moderately equipped and staffed federal regulatory office could easily tackle this level of screening.

Results

Table 6 (opposite) summarizes the list of 302 annotated species provided in full in Appendix B. **Table 6 quantitatively shows, for the first time, the coarse level of risk that the United States is accepting in this import trade.** Extensive policy discussions about this risk have occurred in the past, but they have always lacked the benefit of this quantitative dimension.

As noted, the screening Defenders and ISSG conducted does not amount to a full risk assessment for the 302 annotated species and should not be considered definitive as to "non-risk" for any of the 1,939 "non-annotated" species of the 2,241 non-native animals imported. A more thorough review of each imported species would most assuredly reveal additional risk annotations. The 302 risk-annotated species likely reflect the most common, longest-traded and most studied animal species. The lack of a risk annotation for a particular species may simply mean its invasiveness or disease risk has never been scientifically studied. The species may be entirely new to the wildlife trade, as collectors continually seek new pet and aquarium species from remote and previously unexploited areas. Or the animal may be rarely traded or traded in such low numbers that it has drawn little regulatory scrutiny.

Along similar lines, the much lower proportion of risk annotations in Table 6 for all invertebrates (3 percent) as opposed to all vertebrates (16 percent) appears unlikely to indicate that invertebrates actually pose far less overall risk. While the question is open, a partial explanation may be that scientists simply have not studied invasiveness and disease risk in invertebrates for as long or in the detail that they have studied vertebrates. (The exceptions to this are the distinct categories of invertebrate agricultural pests and human disease vectors that are unintentional rather than intentional imports.) Additionally, information about intentionally imported invertebrates may be more obscure and difficult to obtain for the sort of coarse, high-volume risk screening conducted here. Invertebrate groups with large numbers of imported non-native species (Table 1), such as arachnids (spiders,

Escaped or released from captivity, rhesus macaques like this one have successfully colonized areas of southern Florida.

etc.—92 species), cnidarians (corals, anemones, etc.—182 species) and others, present vast uncertainty as to their potential risk in the wild in the United States.

The same absence of readily accessible scientific studies may also partly explain the relatively low proportion of risk annotations noted in Table 6 for amphibians (8 percent) and reptiles (7 percent), in contrast to the more-studied birds (23 percent), fish (30 percent) and mammals (23 percent). On the other hand, it may be that amphibians and reptiles are inherently less risky groups overall as far as invasiveness or disease. The relative proportions of preliminary risk annotations for the different taxonomic groups presented in Table 6 may serve to frame the questions for future research and analysis.

Some scientific models are available to predict whether previously unstudied species may present risks based on key characteristics that correlate with invasive potential in U.S. habitats. (The accuracy and utility of predictive modeling are discussed in more detail in Chapter 5.) None of the 302 potentially risky species listed in this report were listed solely based on predictive modeling.

In most of the vertebrate groups a significant number of annotations are for disease risk. Several species in Appendix B are annotated for both invasiveness and disease risks. Defenders recognizes this distinction is somewhat arbitrary, as a non-native pathogen causing a disease in a native animal also could be considered as "invasive." For the general purposes of this report, invasiveness does not include this ability to infect another species. Disease risks to humans, livestock and nonlivestock, and disease and pest risks to plants, are separate risk categories. Table 7 summarizes the number of annotations in each of these major risk categories.

Multiple-risk imported species include:

- *Acridotheres tristis*, the Indian or common mynah bird, which has several

Table 6. Proportion of Risk-annotated, Non-native Animal Species Imported to the United States, 2000-2004

Taxonomic Group	Total Imported Non-native Species	Non-native Species with Risk Annotations	Proportion of Non-native Species with Risk Annotations
VERTEBRATES			
Amphibians	172	13	8%
Birds	559	129	23%
Fish	121	36	30%
Mammals	263	61	23%
Reptiles	710	52	7%
TOTAL VERTEBRATES	1,825	291	16%
TOTAL – ALL INVERTEBRATES	416	11	3%
GRAND TOTAL	2,241 species	302 species	13%

Source: 2000-2004 FWS LEMIS data and annotation sources cited in Appendix B

KEY FINDINGS

The research and risk screening conducted for this report revealed several key findings on U.S. animal imports:

- The number of identified, non-native, imported animal species is 2,241.
- At least several hundred additional non-native species were imported but not risk-screened for this report because their full species identification was not in the publicly available LEMIS data.
- The number of identified non-native species with annotations in the coarse-meshed risk screening, summarized in Appendix B, is 302 (291 vertebrates and 11 invertebrates).
- The overall proportion of risk-annotated imported species is 13 percent (16 percent for vertebrates; 3 percent for invertebrates).
- The preliminary risks revealed by the screening process were predominately for invasiveness in all of the major taxonomic groups. However, human disease and nonlivestock animal disease risks also are common in birds and mammals, many species of which are annotated for multiple risks. A small number of human and animal disease risks also are found in the annotations for imported reptiles.

invasiveness annotations and can carry the deadly bird disease, avian influenza (AI) that can also infect humans.

- *Melopsittacus undulates*, the budgerigar, which has invasiveness annotations and can carry AI and another deadly bird disease, West Nile virus.
- *Macaca mulatta*, the rhesus macaque, which has successfully invaded areas of southern Florida and several other locales worldwide and can transmit human diseases, including the herpes B-virus that can cause a potentially fatal meningoencephalitis. Although these macaques can only be imported for scientific purposes, many states allow them to be sold as pets once they have entered the country.

The fact that 13 percent, or nearly one in seven, of the imported non-native species screened has at least one risk annotation underscores legitimate fears about this trade that have long been expressed qualitatively in policy discussions but never in the cumulative, quantitative terms presented in this report. **With more than 300 known potentially risky species imported, it is foreseeable, based on past experience, that some of these animals will escape or be released and form viable wild populations and/or cause disease outbreaks.** In the absence of policy reforms, these and other species added to the import list since 2004, plus the hundreds of additional species not screened for this report because they were not adequately identified, will continue to be imported for unrestricted use and sold and bred widely. The potential risks of escapes, releases and outbreaks predictably will increase as the trade expands in volume and number of species. The next two chapters examine these risks in more detail.

Table 7. Number of Risk-annotated Imported Species by Risk Category, 2000-2004

Taxonomic Group	Total Risk-annotated Species	Invasiveness Risk	Human Disease Risk	Livestock Animal Disease Risk	Nonlivestock Animal Disease Risk	Plant Pest, Plant Disease or Other Risk
VERTEBRATES						
Amphibians	13	7	0	0	8	0
Birds	129	107	28	0	28	0
Fish	36	36	0	0	0	0
Mammals	61	40	22	4	24	1 (other)
Reptiles	52	45	4	3	3	0
TOTAL VERTEBRATES	291	235	54	7	63	1
TOTAL – ALL INVERTEBRATES	11	11	0	0	0	0
GRAND TOTAL	302	246	54	7	63	1

Source: Appendix B

* Numbers in the total column on the left do not equal the sum of the numbers in the risk columns because many species were annotated for two or, in some cases, three risk categories. For the total of imported non-native species in each category, see Table 6. Also note that the table entries are approximations because the preliminary risk annotations in Appendix B do not include all available risk information.

CHAPTER TWO

THE ENVIRONMENTAL IMPACTS OF INVASIVE SPECIES

Non-native animals that become established and cause harm can "biologically pollute" natural and semi-natural habitats. Unlike many other forms of pollution, biological pollution may not dissipate and become less harmful over time. Indeed, if an invasive species can survive and breed outside captivity, it can increase—sometimes exponentially—in terms of population density, geographic range and adverse impacts. One example, the nutria *(Myocastor coypus),* a large, semi-aquatic rodent imported from South America for fur production in the 1930s, has spread along the Gulf Coast and Mid-Atlantic States. With its high reproductive rate, voracious appetite and lack of predators, the nutria is still causing widespread environmental damage 70 years after escaping from captivity, despite concerted, multi-million-dollar control programs. Nutria damage crops and lawns and their burrows undermine the banks of rivers and canals in the bayous of coastal Louisiana and other fragile areas. They eat the shoots and roots of reeds and can clear entire marsh areas of vegetation, turning once-productive areas into open waters or mudflats and threatening the survival of some rare native birds.[12]

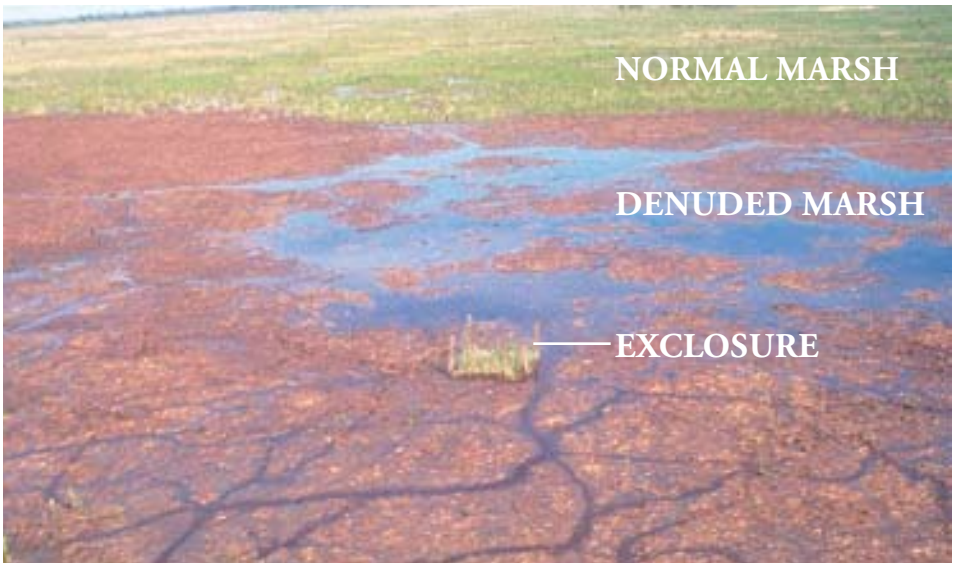
Several studies have addressed invasive animals such as the nutria, but none as comprehensively as the 1993 U.S. Congress Office of Technology Assessment (OTA) report, *Harmful Non-Indigenous Species in the United States.*[13]

The OTA report noted that of the 212 total vertebrate species of non-U.S. origin (142 terrestrial plus 70 fish) that had established wild populations in the United States, 48 (23 percent) were originally imported as cage birds or other pets. It also identified the aquarium fish trade as the source of at least 27 established fish species. In just the 11 years from 1980 to 1991, releases from aquaria led to successful invasions by at least seven new non-native fish species and a total of six mollusk and crustacean species.[14] The OTA report further stated: "Given the high U.S. rates of pet imports—estimated to be hundreds of thousands to millions of wild birds, aquarium fish, and reptiles annually—the potential for pet escapes and releases is great."[15] As the findings herein show, this is still true today.

In noting the import of a non-native species led to a high probability of its eventual release somewhere in the country, OTA highlighted aquaculture species in particular (emphasis added):

Pessimism about the ability to keep aquaculture species confined is so great that, according to some, including the federal interagency Aquatic Nuisance Species Task Force, species maintained for this purpose are ***virtually guaranteed of eventually escaping*** *to the wild.*

Of the 226 terrestrial vertebrates and fish OTA assessed (predominately of non-U.S. origin, but also some translocated U.S.-origin invasives), it classified about 26 as "high impact" invaders, causing severe environmental, economic or health impacts.[16] (Note: The scope of OTA's analysis excluded several taxonomic groups, such as cnidarians, crustaceans and marine mollusks, in which additional high-impact invaders would be expected.) Almost all of the harmful invasive species OTA evaluated would have, at one time, appeared on lists of imported species (such as the 2000 to 2004 U.S. Fish and Wildlife Service (FWS) records described in Chapter 1) had they



LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

A Louisiana wetland graphically shows the results of overgrazing by nutria, an invasive semi-aquatic rodent that has damaged more than 46,000 acres of the state's marshes.

ESTIMATED NUMBER OF ESTABLISHED, NON-U.S. ORIGIN SPECIES, AS OF 1991:

Terrestrial vertebrates	142
Fish	70
Mollusks, nonmarine	91
Insects and arachnids	>2,000
Total	**>2,303**
Total vertebrates	212

SOURCE: OTA, 1993

JOHN RANDALL/HAWAII BISHOP MUSEUM/U.S. GEOLOGICAL SURVEY

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Poison-spined red lionfish (left) now ply the western Atlantic, the first documented occurrence of a tropical, non-native marine fish established in the wild by "pet dumping." Another aquarium escapee thriving in the natural world, the suckermouth catfish (right), attaches itself to a manatee in Florida's Blue Spring Run to feed on algae growing on the endangered marine mammal's back.

been kept. As it was, regulatory actions were not taken to block them.

Since OTA's report, no one has published a systematic nationwide analysis of new harmful animal invasions. Meanwhile, several more species have invaded since 1993. Without policy reforms, the import trade, which now includes at least 2,500 non-native species when all unidentified species and new additions are taken into account, will continue to lead to invasions.

Pathways of Animal Invasion

The OTA report found that only a small number of new, non-native animals are imported for the purpose of intentional release by government agencies, or others with governmental permission, seeking to establish new wild populations.[17] While common in the early 1900s, the stocking of "sportfish," "game animals" and other species has declined considerably. The more typical pathways to the wild now are the escape of aquaculture species from captivity, the deliberate release of pets and aquarium fish and the discarding of live fish bait.

People regularly "free" animals without permission, often in violation of state and federal laws.[18] Pet owners abandon animals they can no longer keep or no longer want and are unable or unwilling to place in a new home or to euthanize. In some cases, a release is intended to establish new populations in the wild, presumably for sport or consumption. The latter motivation is believed to be behind the presence of the northern snakehead fish, a popular Asian delicacy, in the Potomac River drainage.[19]

The successful establishment of a non-native species is not a single event, but a process that can take many years or decades. Many released or escaped non-native animals often die off in their new location, but a proportion—estimated at as much as 50 percent for some species—may establish a self-sustaining population.[20] At the next stage of invasion, many such species remain localized, and most probably are not even detected by humans. Some populations remain localized for years. However, a proportion of such established species, again as much as 50 percent for some animals, may spread farther and become abundant in many new locales.[21] Per the OTA estimated numbers (page 15), more than 300 species had successfully invaded the United States through 1991 just among the terrestrial vertebrate, fish and freshwater mollusk groups OTA covered.

Ecological Risks of Invasions

In a major 1998 study, Wilcove et al. reviewed all federal Endangered Species Act listings and found that, after habitat destruction, invasive plant and animal species were the second most commonly identified contributing factor, affecting about one-half of listed threatened or endangered native species.[22] Invasive non-natives can out-compete, prey upon, parasitize or transmit diseases to natives.[23] They also can alter the physical environment, modifying or destroying natural and semi-natural habitats. Particularly on islands, and in island-like habitats such as isolated lakes and springs, invaders that can out-compete native species often have in essence replaced them.

Complete extirpations or extinctions of native animals and plants do not have to occur for biological communities to be altered radically. Nor are extirpations or extinctions necessary for the United States to experience a significant decline in the native biological diversity and aesthetic value of its natural areas. Declines in populations of native species resulting from animal introductions have been seen across an array of ecosystems, for example:[24]

- Competition from European starlings and house sparrows caused dramatic declines in eastern bluebirds, redheaded woodpeckers and other native birds.
- Introductions of mosquitofish led to local declines in at least 15 rare native

fishes found in western desert streams and springs.
- The introduced crayfish, *Orconectes rusticus*, competed with native *Orconectes virilis* and caused its local disappearance from numerous Wisconsin lakes.

The ecological damage done by invasive animals also has an economic impact. (For a detailed discussion of the economics of non-native animal imports, visit www.defenders.org/animalimports.)

Recent Invaders

As of 1991, dozens of invasive species in the United States were identified as harmful overall ("net harmful") by experts retained by Congress's OTA. Yet, at least 18 of those harmful invaders still were being legally imported during the 2000-2004 period examined for this report (Table 8).[25]

Since 1991, several other non-native animals not listed in Table 8 and not previously identified as harmful have invaded. (In addition, several new human and animal diseases have been imported via this trade since 1991; see Chapter 3 and Table 9.) Several examples of invaders that have become prominent since 1991 are briefly described below.[26]

Burmese python *(Python molurus).*[27] This huge snake native to southern Asia is common in the pet trade. Due to difficulties in raising these snakes that can reach lengths approaching 10 feet in just a few years and live for 25 years, some owners have released them into the wild. This has caused widespread concern as Burmese pythons are predators that occupy a place at the top of the food chain and kill native wildlife. Wildlife officials have captured hundreds of them in the Florida Everglades, where free-ranging Burmese pythons likely exceed 1,000 in number and compete with alligators, the dominant predators in the Everglades. Controlling them by trapping and removal is difficult, expensive and dangerous work.

Red lionfish (*Pterois volitans*).[28] This carnivorous tropical fish from the Indo-Pacific introduced via aquarium releases has formed wild populations in the western Atlantic, the first documented establishment of a non-native *marine* fish linked to private pet releases. The red lionfish is a risk to humans because of its venom. When confronted, the fish arches its back, points its long sharp dorsal spines and swims forward rapidly to inflict a sting, most commonly to the hands of divers and anglers. Careless touching of recently dead fish also can cause stings, which can result in severe pain, swelling, redness, bleeding, numbness, joint pain, anxiety, headache, disorientation, nausea, paralysis and convulsions. Negative ecosystem effects have not been observed to date as the number of lionfish is relatively small. However, future effects on marine communities from Florida to as far north as New York may occur if these aggressive predators that feed on shrimp and fish—including the young of important commercial species such as snapper and grouper—continue to reproduce and disperse.

Suckermouth catfish (*Hypostomus* spp.).[29] Also known as the armadillo del rio, this catfish was introduced to Texas and Florida rivers in the mid-1950s and early 1960s and to other locations soon after. Reproducing populations exist in Nevada and Hawaii and specimens have been reported from at least six other states (Arizona, Colorado, Connecticut, Florida, Louisiana and Pennsylvania). Suckermouth catfish create branching, horizontal burrows up to four feet deep on stream or pond banks. Their distinctive feeding and reproductive behaviors, coupled with high population densities, pose significant threats to native fish communities and aquatic habitats. Documented and potential impacts include disruption of natural food chains, mortality of endangered shore birds that consume

Table 8. Harmful Non-native Animal Species in the United States as of 1991 Still Being Imported in 2000-2004

	Scientific Name	Common Name
BIRDS	*Acridotheres tristis*	Indian mynah
	Aratinga pertina	Brown-throated conure
	Brotogeris versicolurus	Canary-winged parakeet
	Cygnus olor	Mute swan
	Gracula religiosa	Hill mynah
	Lonchura malacca	Chestnut manikin
	Lonchura punctulata	Nutmeg manikin
	Myiopsitta monarchus	Monk parakeet
	Pycnonotus jocusus	Red-whiskered bulbul
	Zosterops japonicus	Japanese white-eye
MAMMALS	*Axis axis*	Axis deer
	Oryctolagus cuniculus	European rabbit
	Sus scrofa	Feral pig
FISH	*Carassius auratus*	Goldfish
	Cyprinus carpio	Common carp
	Poecilia reticulata	Guppy
	Xiphophorus helleri	Green swordtail
INVERTEBRATES	*Achatina fulica*	African giant snail
TOTAL:	**18 species**	

Source: Appendix B, all species with "91 OTA" annotation

these sharp-spined fish and changes in aquatic plant communities. In Florida, suckermouths have been observed feeding on the algae that grows on the backs of manatees, causing the endangered marine mammals to expend valuable energy to dislodge the grazing fish.[30] According to the U.S. Army Corps of Engineers suckermouth catfish "present a cumulative series of threats to aquatic ecosystems unprecedented in recent history."[31]

Great green tree frog (*Litoria aurea*). This large Australian frog has been released in Florida where it may compete with native frogs. Great green tree frogs are considered invasive in New Caledonia.[32] They can easily swallow Florida's native tree frogs and other small vertebrates. They also can carry the deadly frog pathogen *Batrachochytrium dendrobatidis* (B.d.). If B.d. spreads to native amphibians, the results could be devastating (see Chapter 3).[33]

Potential Invaders

The following imported species present apparent risks. However, unlike the animals described above, they are not known to have established U.S. populations in the wild—yet.

Nile perch *(Lates niloticus).* This voracious predator's deliberate introduction in the mid-1900s was responsible for the catastrophic extinction of more than 100 endemic fish species in East Africa's Lake Victoria in fewer than 30 years. The Nile perch could wreak similar havoc in the species-rich waters of many U.S. lakes and rivers if introduced here. Its value as a commercial species makes deliberate introduction here an enduring possibility, even if done illegally.

Australian redclaw (*Cherax quadricarinatus*). This Australian freshwater crayfish is a hardy species very tolerant of environmental changes. It is classified as a harmful invader in South Africa.[34] Florida has banned its use in aquaculture except in free-standing tanks.[35] Introduced non-native crayfish can displace native crayfish species, transfer disease, consume fish eggs, reduce fish stocks and cause other more subtle ecological impacts.[36]

Central American agouti (*Dasyprocta punctata*). This is a medium-sized rodent native to Central and South America reported as invasive in the Cayman Islands.[37] It is adaptable to a variety of habitats and may present invasiveness risks in warm areas of the United States comparable to those posed by the nutria.

The examples above do not begin to exhaust the full range of potential invaders and environmental risks. As noted previously, the annotated species list in Appendix B from which the case studies were drawn has limitations:

- The imported species list is incomplete. Hundreds of additional species were not fully identified, thus any potential risks they pose have evaded even the preliminary screening conducted here.
- The list only covers 2000 to 2004. Dozens or even hundreds of new species likely have been imported since 2004; still others were imported prior to 2000 but not thereafter, and their risks have not been considered here.

More than 1,000,000 *other* non-U.S. native animal species, not known to be in the import trade now, are known to exist on the planet. These are mostly invertebrates, but the total includes about 50,000 vertebrates.[38] Almost any of these could be legally imported with no prior risk assessment under the current system (see Chapter 4).

The Added Risk of Global Warming

Global warming and species invasions are major changes that can increase pre-existing stress levels for native species and their habitats.[39] Global warming and the suite of habitat alterations it induces confound attempts to make reliable predictions regarding invasiveness risk in the United States. Basic decisions about what constitutes a "non-native" species can get complicated when the normal ranges of species are shifting with changing climatic conditions caused by human actions.

The number of harmful species invasions is likely to increase in a warming North America. More introduced tropical species will be able to acclimate without the colder temperatures that previously limited their ability to survive and over-winter. These new invaders may include hot-climate disease carriers, such as more species carrying West Nile virus, which was first identified in Egypt and believed to have come into the United States from Israel.

Changed precipitation patterns, nutrient levels, pH, ultraviolet light radiation and other factors associated with changed climate conditions can reduce survival rates for specialist native species, allowing generalist invaders to flourish. Climate-related stress can render native species more vulnerable to the effects of introduced pests and diseases. In sum, global warming opens new frontiers for invasives and makes conservation of natives even more challenging.

More Invasions Likely

Non-native animals able to survive initially in the wild can remain as localized minor phenomena or eventually disappear. Others may become established, spread widely and fundamentally alter natural ecosystems. The United States already has hundreds of established invasive animals, including at least 26 considered by OTA experts to be "high impact." More are likely to follow based on the volume and identifiable risks presented by the trade.

The United States encompasses extraordinary and unique natural habitats, both terrestrial and aquatic. Invasive animals and plants from around the world are increasingly "homogenizing" these environments, reducing—and in some cases effectively eliminating—native species. Global warming will likely benefit some of these invaders.

CHAPTER THREE

THE HEALTH RISKS OF LIVE, WILD ANIMAL IMPORTS*

In the wake of the 2003 outbreak of severe acute respiratory syndrome (SARS)[40] and with the recent permanent establishment of West Nile virus in the United States and the high anxiety surrounding the H5N1 avian influenza virus, a growing community of health professionals has recognized that the wildlife trade is understudied and lacking in regulation.[41] The scope of the wildlife trade—in particular the rate at which a wide variety of live animals are traded among widely disparate regions—poses serious risks of cross-species transmission of microbes that animals naturally carry. It is because of this rapid potential for introduction of pathogens into new host animals, combined with the lack of prior opportunity for the new hosts to evolve immunity, that introduced diseases represent such a dramatic threat to domesticated animals, to native wildlife—and to humans.

The United States is the world's leading import market for live animals, yet the majority of them are never tested for infectious agents. Only commercial imports of birds and a few livestock species and other animals are tested, and most imported species are not quarantined (see Appendix C). Regular monitoring for diseases in groups such as tropical fish is nonexistent, yet these animals can carry harmful infectious agents such as mycobacterium.[42] This low level of surveillance is unjustified in view of the diversity of new diseases that have emerged in the United States from animal imports (Table 9). A basic lack of knowledge surrounds the infectious agents associated with animal imports and ultimately reduces the ability of regulatory officials to respond effectively to the trade.

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A civet cat awaits its fate in a Chinese food market. Researchers traced SARS to a previously unknown virus carried by civets and badgers in the packed live animal markets of southern China.

Animal Imports and Emerging Infectious Diseases

Disease-causing organisms are natural components of virtually all populations and ecosystems. However, scientific research suggests new diseases are emerging at unusually high rates in domesticated animals, wildlife and humans.[43] Emerging infectious diseases include diseases caused by pathogens and parasites that have recently increased in incidence, host species occupied or geographic extent; newly discovered diseases and diseases caused by newly evolved agents.[44] The apparent increase in emerging infectious diseases has raised serious concerns globally. Given the variety of catastrophic results that major outbreaks can impose—death and personal hardships, a reduced or weakened work force, damage to the food supply, extirpation of native animals—such concerns are warranted.[45]

The research indicates a large number of emerging diseases result from "pathogen pollution," that is, the human-driven introduction of novel infectious agents to new locations.[46] While pathogen pollution may be on the rise, it is not new; humans have facilitated the spread of diseases throughout history.[47] Europeans traveling to the New World, for example, brought with them numerous non-native animal and plant species that hosted novel infectious agents—agents that ultimately spread to native wildlife, native plants and indigenous people.[48] Yet, in an age characterized by the rapid breakdown of old barriers between people and nature, pathogen pollution and the continued emergence of infectious diseases are more important than ever.[49] The practice of shipping live animals around the globe with minimal surveillance magnifies the risks.

*This chapter was prepared by the Consortium on Conservation Medicine, primarily by Katherine F. Smith, Ph.D.

Several aspects of the wildlife import trade in particular pose potential health threats to the United States:

- **Quantity and diversity of animal imports.** The huge numbers of diverse species shipped through numerous ports of entry each year raise the likelihood that a new infectious disease will be introduced (see Chapter 1, Tables 1 and 2). Because the vast majority of imported species are not U.S. natives—85 percent of vertebrates and 82 percent overall—a significant proportion of the infectious agents they harbor are also likely to be foreign to humans, domestic animals and native wild animals in the United States. This is particularly important because native populations afflicted by exotic agents lack the benefit of prior host-pathogen co-evolution and therefore may lack immune defenses with which to fight the new infections. Depending on the infectious agent, individual impacts such as this can scale up to pose broad implications for public health, animal health and the health of natural ecosystems. Increased understanding of the impacts of exotic infectious diseases on individuals and populations will help prioritize those that pose the greatest risk and require immediate surveillance and response.

- **Geographic breadth of imported species.** Animals are imported from about 160 countries (Appendix A, Item 8). The majority is from Southeast Asia, a region with a high incidence of emerging infectious diseases in humans, domestic animals and wildlife (see www.conservationmedicine.org). Of equal concern is the likelihood that many yet unidentified infectious agents occur in animal populations harvested for this trade. This makes it extremely difficult to determine which imported species pose the greatest risk of carrying harmful agents. Developing preventative programs without this knowledge presents a formidable challenge.

- **Increased transmission within and among imported species.** Infectious diseases are transmitted between hosts in a variety of ways: from parent to offspring, through direct contact and via aerosols (airborne particles), vector hosts such as ticks, fleas and mosquitoes) and inanimate objects such as contaminated vehicles, food and water. The transmission of infectious agents generally exhibits some form of positive **density dependence**—as the density of potential hosts increases, so, too, does the risk of an individual becoming infected. Along wildlife trade routes, many situations occur where animals are held at unnaturally high densities—for example, at captive breeding facilities and in shipping containers. Shipments may also be collated in ways that bring multiple species into close contact, allowing transmission of infectious agents between unnatural species pairs. Finally, shipping containers and holding facilities at ports may be

Table 9. Infectious Agents Introduced to the United States via Imports of Live, Wild Animals, 1996-2006

Infectious Agent	Most Recent Documentation	Imported Host	Known Carrier Hosts	Infected Animals	Status in U.S.
Exotic Newcastle's Disease[i]	1999	Various avian species	Various avian species	Poultry	Localized, recurring outbreaks
Heartwater[ii]	2000	African tortoise tick	Lizards, snakes, and tortoises	Domestic livestock, white-tailed deer	Present
Malignant Catarrhal Fever[iii]	2002	Ankoli cattle	Wildebeest	Ruminant species	Eradicated
Monkeypox Virus[iv]	2003	Giant Gambian rats	Giant Gambian rats	Humans, prairie dogs	Eradicated
Viral Hemorrhagic Disease of Rabbits[v]	2005	European rabbit	European rabbit	European rabbit	Localized, recurring outbreaks
Chytridiomycosis[vi]	2006	American bullfrog	American bullfrog, African clawed frog	Amphibians	Present
Ranavirus[vii]	2006	American bullfrog	American bullfrog	Amphibians	Present

Sources (all online sources last accessed Dec. 2006):

[i] History of Newcastle Disease in U.S., by S.L. Molenda; online at: www.internationalparrotletsociety.org/historyofend.html.

[ii] African Ticks on Imported Snakes and Tortoises, by M. Kaplan; online at: www.anapsid.org/heartwater.html.

[iii] AnimalNet, Food Safety Network at Univ. of Guelph; online at: www.foodcontamination.ca/animalnet/2002/12-2002/animalnet_december_29.htm, and Center for Emerging Issues, Summary of Selected Disease Events, Oct. – Dec. 2002; online at: www.aphis.usda.gov/vs/ ceah/cei/taf/iw_2002_files/summary2002/disease_summary_101202_files/disease_summary_100902.htm.

[iv] Center for Emerging Issues; Summary of Selected Disease Events, Jan. – June 2003; online at: www.aphis.usda.gov/vs/ceah/cei/taf/iw_2003_files/summary2003/summary_1_to_6_2003_files/disease_summary010603.htm.

[v] California Department of Food and Agriculture, Emergency Disease Program Alert, Animal Health and Food Safety Services, Animal Health Branch, Rabbit Hemorrhagic Disease in Indiana, June 2005; online at: www.cdfa.ca.gov/ahfss/ah/pdfs/RHD-Indiana2005.pdf and USDA APHIS, Rabbit Hemorrhagic Disease; Jan. 2002; online at: www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/fs_ahrabbithd.html, et al.

[vi,vii] L. Schloegel et al., unpublished data. Note: the imports of American bullfrogs are of a native species captive-bred overseas.

contaminated with agents that can survive for prolonged periods and infect animals that come in contact with them. Understanding the transmission dynamics of infectious agents along trade routes will provide critical knowledge for agencies to develop surveillance and regulatory responses.

- **Novel hosts for established infectious diseases.** Even if imported animals do not harbor infectious agents of concern for hosts in the United States, they still may pose health risks. Immunologically naïve non-native animals that are released or escape to the wild may serve as new hosts for infectious agents already established in a resident wild population. These newly resident animals may influence pre-existing host-pathogen relationships.[50] An important component of emerging disease preparedness is to consider those infectious agents already established in the United States and their potential interactions with new non-native species.

- **Evolution of introduced disease agents.** Seemingly harmless infectious agents introduced into the country with imported animals may have the potential to evolve and subsequently infect humans, domestic animals and/or native animals. When faced with novel environmental conditions, infectious agents may undergo selection leading to new strains that can harm new hosts. This may be the case for the H5N1 avian influenza virus, which does not yet spread easily between human hosts, but could do so if it encounters enough opportunities to evolve and adapt.[51] Developing effective control programs will require studying evolution of disease agents after their introduction to new environments in the United States.


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Lesions like these appear on individuals afflicted with monkeypox. Investigators traced a 2003 outbreak of this viral disease in the United States to a shipment of rats from Ghana that infected prairie dogs awaiting sale to pet dealers.

CASE STUDY: MONKEYPOX

Monkeypox is a virus originating from central and West Africa, where it has caused human outbreaks since 1970. In humans, the symptoms of monkeypox are similar to those of smallpox, but typically milder. The illness lasts for as long as four weeks and patients typically experience fever, headache, muscle aches, backache, swollen lymph nodes, exhaustion and a rash. In Africa, monkeypox is fatal to as many as 10 percent of infected people.

In the spring of 2003, monkeypox virus was introduced to the United States via a pet-trade shipment of Gambian giant rats (*Cricetomys gambianus*, on the import list in Appendix B). The rats were sold to several dealers, one of whom housed the animals with a group of prairie dogs subsequently sold to private individuals. Within a few months, 71 people in six states were sickened through bites or contact with body fluids from prairie dogs infected with monkeypox. The effort to eradicate it involved complex collaborations among federal agencies and numerous departments in each of the affected state governments.[58] After this outbreak, the Centers for Disease Control (CDC) banned six African rodent species that were being imported between 2000 and 2004 from further import (see Appendix B, species annotated with "CDC 2003" abbreviation, and Table 11).

Disease Risks to People and Other Animals

The wildlife trade presents many opportunities for the introduction and spread of infectious diseases. As discussed below, once introduced, infectious diseases have profound and varied implications—not just for humans and public health, but also for domestic animals and native wildlife.

Risks to humans and public health

Infectious diseases can harm all people, regardless of age, gender, ethnicity or socio-economic status. Outbreaks cause illness, suffering and death and impose a substantial economic burden for the people infected and for society as a whole.[52] Some diseases have been effectively controlled through technological and medical advancements, but new diseases are constantly emerging (e.g., SARS), re-emerging (e.g., West Nile virus) and appearing in new forms resistant to drug treatments (e.g., malaria).[53] Around three-fourths of diseases known to affect people have a zoonotic origin, i.e., they are transmitted by animals.[54] Zoonotic infectious diseases are an unwanted by product of animal imports.

No single factor explains the emergence

Should avian influenza make its way into the United States via imported animals, poultry operations like this one in rural Arkansas could be wiped out.

CASE STUDY: AVIAN INFLUENZA

Highly pathogenic H5N1 avian influenza (AI) first emerged in people in 1998 in Hong Kong.[61] Since then it has spread throughout Asia and, in 2005, to Russia, Europe and finally Africa.[62] The H5N1 virus causes rapid onset of extremely severe flu symptoms and has a high fatality rate in people. About 50 percent of those infected die. H5N1 AI poses a global pandemic danger that cannot be overstated should the virus evolve the ability to spread more efficiently among humans. According to the World Health Organization, millions of people would likely die and worldwide economic damage could be $200 billion or more.[63]

This virus originated in poultry in Southeast Asia. Its rapid spread across the Old World led a number of scientists to suggest migratory birds are involved.[64] Further evidence emerged that the virus was carried via legal[65] and illegal[66] trade in infected pet birds. Currently, H5N1 AI continues to break out regularly in Southeast Asia and Europe, and the threat to the United States is significant even though it no longer imports poultry from these regions. Should the virus reach this country, even without the more efficient human-to-human transmission route, it would devastate the poultry industry, costing billions of dollars and threatening livelihoods and public health.

A recent analysis of trade routes, as well as wild bird migration routes, showed that the worst threat is from neighboring countries that continue to trade in poultry with European countries that have found H5N1 AI in their birds.[67] Importantly, during much of the time period since the initial discovery of highly pathogenic H5N1 AI, as many as 28 species of live birds and three species of mammals that now are known to likely be capable of harboring the virus were regularly imported into the United States without being specifically tested for the disease (see Table 7 and Appendix B, "USGS AI"-annotated species). A quarantine measure is in place for all imported birds, and while it is unlikely that an infected bird would carry AI through quarantine, it cannot be ruled out. CDC also has been imposing bans on any bird imports from dozens of countries where AI has been documented, although that is an after-the-fact protection (Appendix C).

of pathogens. They generally appear to exploit opportunities that arise to expand their range when people alter the natural environment. This provides new pathways for transmission from humans to other hosts and vice versa.[55] Numerous contacts that can occur between imported animals and humans along the trade routes—with trappers, collectors, breeders, exporters, importers, distributors, dealers and purchasers—increase the opportunity for zoonotic diseases to emerge in the United States. Indeed, many examples exist where these diseases already have emerged (see Table 9).

The devastating impacts of emerging diseases can go well beyond those to the individual. These diseases also greatly stress public health programs, few of which are fully prepared. For example, the SARS outbreak in 2003 resulted in 361 reported illnesses including 33 deaths in North America, almost all in Toronto.[56] Doctors, nurses, hospital staff and emergency medical technicians were unprepared and unvaccinated for this new disease. In some cases they refused to treat patients who presented frightening, unfamiliar symptoms. Some of those health workers who did treat SARS-infected patients were shunned as presenting risks to their families and acquaintances.

Trust for America's Health's 2006 report, *Ready or Not? Protecting the Public's Health from Disease, Disasters, and Bioterrorism*, found that five years after September 11 and the anthrax tragedies, emergency preparedness remains inadequate.[57] The nation's public health system is the first line of defense against threats such as H5N1 avian influenza, SARS and other diseases, but it remains unsuited to the scope of the threats.

Risks to domestic animals

Infectious diseases of livestock and other domestic animals have emerged at high rates in recent decades. Outbreaks of the four most significant of these—bovine spongiform encephalopathy (BSE or "mad cow" disease), foot-and-mouth disease, swine fever and avian influenza—have imposed economic costs globally estimated at **$80 billion**.[59] About 75 percent of infectious agents of livestock animals

also occur in nonlivestock host animals, increasing the likelihood that infections of livestock will be unintentionally brought into the country via imports of other animals.[60] Resulting outbreaks can present serious implications for human health, the economy and native animals as well.

Risks to native wildlife

Diseases are major evolutionary forces because of their profound impact on individual survival and fitness. They have the potential to decimate local populations to the point of extirpation.[68] A survey of U.S. biologists listed infectious disease among the five most important causes of species extinctions in the country.[69] Both historical and theoretical research shows that reduction by disease can predispose wild animal populations to extinction by other forces.[70] In some cases diseases were identified as the major or final cause of extinction.[71]

CASE STUDY: CHYTRIDIOMYCOSIS

In 1998 researchers identified a novel fungal pathogen of amphibians, *Batrachochytrium dendrobatidis* (B.d), as the cause of chytridiomycosis, a skin disease fatal to amphibians that has since been linked to declines and extinctions of frog and toad populations worldwide.[72]

The international trade in amphibians may be disseminating this disease to new regions. The American bullfrog is farmed and transported worldwide for human consumption as frog legs. This species is resistant to the adverse effects of infection from B.d. Recent work shows that bullfrogs are high-risk carriers of B.d. and are imported in growing numbers into the United States for restaurants. They are intensively produced in farms in South America and Asia for the U.S. market, and several studies identified B.d. in these farms or in bullfrogs exported from them.[73]

The United States also imports several million live amphibians annually (see Table 2). At least six non-native species among these imports pose risks of B.d. infection (see Appendix B, amphibian annotations). These animals, if infected, would threaten U.S.-native amphibians should the disease be spread into naïve populations. Nevertheless, no mandatory testing or quarantine program exists.

Potential Risks from Infectious Diseases Emerging Abroad

The past three decades have witnessed the repeated emergence of new diseases that infect people from wild and/or domesticated animals.[74] Some of these zoonoses (animal diseases that can be transmitted to humans—HIV/AIDS and pandemic influenza, for example) caused dramatic outbreaks and global loss of life. Others, such as Ebola, Nipah virus and hantavirus, caused localized outbreaks, but remain a threat because of their lethality and potential for spread.[75] The initiation of disease emergence from animals to humans is complex, but begins with repeated "spillover" of pathogens from wildlife or domestic animals into a small number of people. This becomes more significant when the infected people then travel and/or trade goods. Interactions and connection within the global community eventually lead to "pandemic" emergence, such as occurred with HIV/AIDS with the bushmeat hunting of chimpanzees that appears to have led to spillover to humans in Africa.[76] HIV/AIDS only became a problem in Western countries when urbanization and air travel within Africa both increased to the point where villagers infected with HIV came into frequent contact with city dwellers. Then the virus quickly spread via air travel to other countries.

The likelihood of new zoonoses spilling over into people abroad and then being introduced into the United States remains high. Just such an event occurred with SARS, which recently emerged from the wildlife trade in China,[77] rapidly spread throughout Southeast Asia and then, via air travel of infected people, into Europe and North America (primarily Canada but also the United States).

The geography of diseases suggests that infectious agents that infect *humans only,* particularly viruses, bacteria and agents that do not require other vectors for transmission, have already had the greatest opportunity for rapid spread across the globe.[78] In contrast, although many zoonotic infectious agents also are broadly distributed, a much larger proportion of them remain fairly localized on particular continents and in certain nations compared to the "humans only" agents. Among these zoonoses, the parasites, viruses and others that require vectors for transmission still have the most limited distribution and are the agents most likely to emerge in the form of novel diseases in the future. In other words, they still have the highest potential for spreading to more locations where they have not been seen before. **If not better regulated, the global trade in live animals that are zoonotic disease vectors will be a driving force in future outbreaks.**

Two crucial questions preoccupy researchers in this field: Which zoonotic pandemic disease will emerge next? Where will it come from?[79] While research will help target regions for surveillance, increased monitoring and regulation of imports of non-native animals would also greatly enhance the odds of preventing the next animal-carried pandemic. Critical steps will be to study potential emerging zoonotic infectious agents on a case-by-case basis, examine their risks in more detail and determine which ones have the potential to cause major epidemics in the United States. Taking these steps will require greater collaboration among epidemiologists, public health officers, biologists, veterinarians and regulatory officials.

CHAPTER FOUR

BROKEN SCREENS: NATIONAL LAWS ON ANIMAL IMPORTS

Do our current laws allow for proactive analysis, i.e., pre-import screening of the risks non-native species may pose before they are brought into the United States? That is the main policy concern of this report and addressing it begins with the recognition that no single overarching federal law governs these imports.* No law mandates a comprehensive assessment of the potential risks from a given non-native species to the environment, the economy and human and animal health within the United States. The primary federal statutes that apply to invasiveness, disease and other potential risks associated with intentionally imported live animals regulate within limited categories of risk. This piecemeal system puts three main agencies in charge: the Department of the Interior's (DOI) U.S. Fish and Wildlife Service (FWS); the Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS); and the Department of Health and Human Service's (DHHS) Centers for Disease Control and Prevention (CDC).[80]

Agencies and Authorities

Table 10 illustrates the coverage of the main statutory authorities by which FWS, APHIS and CDC regulate. (See Appendix C for a summary of the rules and regulations restricting live animal imports under these statutes and of other conservation-oriented statutes and regulations that may incidentally affect imports of protected species.)

FWS and the Lacey Act

The Lacey Act "injurious species" provisions, first adopted in 1900 and amended several times since, prohibit imports of animals that have been individually determined in the statute itself or by regulation to be "injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States."[81] About 35 taxa in total are listed as injurious, mostly at the species or genus level. Most of the listings are mammals, birds and fish; only two invertebrates, one reptile and no amphibians are listed.[82] Anyone seeking to import a listed injurious species for "zoological, educational, medical, or scientific purposes" must obtain a FWS permit.[83] Several listed species are imported in significant quantities under these permits.

FWS administers regulations covering the procedural and recordkeeping aspects of imports of all wild animals.[84] A person in this business must obtain a license from the agency.[85] This includes animal dealers and pet suppliers.[86] *A Declaration for Importation or Exportation of Fish or Wildlife*—Form 3-177—must accompany each live animal shipment.[87] This form should state the common and scientific names of the species, the country of origin and the purpose for which it is being imported.

FWS officers must clear all shipments of wild animals before they can be taken beyond the port.[88] Shipments can be detained or refused if the species is prohibited, or if the required documents are not presented or are incomplete or inaccurate—for example, the species are not identified by full scientific names or are misidentified.[89]

APHIS and the Animal Health Protection Act and Plant Protection Act

Under the Animal Health Protection Act (AHPA), APHIS may prohibit imports of particular animals or prohibit specific "means of conveyance" to prevent the introduction of "any pest or disease of livestock."[90] This authority is narrow by its terms, focused only on pests and diseases of farm animals such as cattle, horses, sheep and swine. APHIS has banned three species under this authority, has imposed limited bans on a few other species as far as shipments from certain source countries, and imposed quarantines for several animal imports, mostly common pets, livestock and birds (see Table 10 and Appendix C).

The AHPA does not give general coverage of potential diseases and pests of nonlivestock animals, i.e., wild animals. For example, APHIS lacks authority to regulate animals that can transmit one of the most threatening wildlife diseases, *Batrachochytrium dendrobatidis*, (B.d.), which afflicts amphibians and is contributing to their drastic decline worldwide (See Chapter 3). However, within its statutory limits, APHIS has used its extensive authority to address livestock threats such as mad cow disease, foot-and-mouth disease and screwworm flies.

The Plant Protection Act (PPA) regulates invertebrate plant pests designated by APHIS.[91] APHIS has banned approximately 100 individual invertebrate plant pest species, plus many other whole classes and orders of invertebrate pests. Imports of known plant pests require an APHIS permit.[92] Although the PPA provides comprehensive authority to regulate animal imports to protect plants and plant health, it gives no authority to address non-plant-related risks.

In sum, the AHPA and PPA coverage of live animal imports is narrow. The statutes allow, but do not require, effective screening of intentional animal imports before they come into the country to keep out those animals, almost all invertebrates, that are pests or disease threats to domestic livestock or plants.

*As stated in Chapter 1, the 50 states lack the authority in the federal constitutional system and the ability, excepting Hawaii and perhaps Alaska, to effectively regulate international imports of, and interstate commerce in, animals not native to the United States.

Table 10. Primary Agencies, Authorities and Restrictions for Imports of Live Animals

Agency	Basic import regulation statute	Criteria for regulating animals in agency's basic import regulation statute	Animal taxa covered under agency's current import restrictions
USDOI FWS	Lacey Act 18 U.S.C. § 42	"…such…species of wild mammals, wild birds, fish (including mollusks and crustacea), amphibians, reptiles, …which the Secretary of the Interior may prescribe by regulation to be injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States, is hereby prohibited."	About 35 taxa (species and genera) prohibited without a FWS permit, mostly mammals, birds, and fish
USDA APHIS	Animal Health Protection Act (AHPA) 7 U.S.C. § 8303(a)	AHPA: "…Secretary [of Agriculture] may prohibit or restrict…the importation or entry of any animal… if the Secretary determines that the prohibition or restriction is necessary to prevent the introduction into or dissemination within the United States of any pest or disease of livestock…"	AHPA: 3 tortoise species banned for vectoring a livestock disease; quarantines for several animal imports, mostly common pets, livestock, and birds
	Plant Protection Act (PPA) 7 U.S.C. § 7711(a)	PPA: "…no person shall import, enter, export, or move in interstate commerce any plant pest, unless the importation, entry, exportation, or movement is authorized under general or specific permit and is in accordance with such regulations as the Secretary may issue to prevent the introduction of plant pests into the United States…"	PPA: approximately 100 invertebrate plant pest species prohibited, plus many other whole classes and orders of invertebrate plant pests
DHHS CDC	Public Health Service Act (PHSA) 42 USC § 264(a)	"[DHHS is]…authorized to make and enforce such regulations as in his judgment are necessary to prevent the introduction, transmission, or spread of communicable diseases from foreign countries into the States or possessions, or from one State or possession into any other State or possession…"	Potential human disease vectors are prohibited without a permit, including about 21 taxa/groups specifically listed

A woman and her children wear masks to protect against SARS during the 2003 outbreak in China that grew into a worldwide menace. After the deadly virus was linked to civets sold in the live animal markets of China, the CDC banned the import of all civets to the United States.

CDC and the Public Health Service Act

Under the Public Health Service Act (PHSA), CDC is authorized to issue regulations to prevent the introduction and spread of communicable human diseases from foreign countries.[93] The CDC director can order the suspension of imports from any country without first needing to issue regulations, if a rapid order is needed to counter an immediate threat.[94] CDC exercised this authority on several recent occasions in reaction to outbreaks of severe acute respiratory syndrome (SARS), which was first reported in Asia in 2003 and quickly spread internationally. In January 2004, six months after the SARS outbreak had been generally contained, CDC prohibited the import of live or dead civet cats, a SARS vector.[95]

In May 2003, monkeypox, another animal-transmitted virus appeared. In June 2003, the CDC issued an order prohibiting imports of rodents from Africa; that order was later adopted as a regulation.[96] While that order aimed narrowly, when the CDC issued its final monkeypox regulation in the *Federal Register,* the agency directly admitted its approach until then had been inadequate and clarified the broad scope of its power under the PHSA (emphasis added):[97]

If another outbreak of a different zoonotic disease occurred in the United States, we would take actions comparable to those we have taken to address monkeypox, modifying those actions as appropriate to the new circumstances. However, ***we believe that the introduction of monkeypox into the United States shows that we need to develop measures to prevent or minimize the likelihood of other zoonotic disease introductions or outbreaks****. As noted in section IV of this document, section 361 of the PHS Act authorizes the Secretary to make and enforce such regulations as judged necessary to prevent the introduction, transmission, or spread of communicable diseases from foreign countries into the States or from one State to another State. We may regulate intrastate transactions under this authority as appropriate (see State of Louisiana v. Mathews, 427 F. Supp. 174 (E.D. La. 1977)). We may, therefore, publish a document in the Federal Register that would discuss possible regulatory approaches, such as:*

Banning the import into the United States, as well as the capture, sale and distribution within the United States, of certain categories of animals *(e.g., rodents, marsupials, and bats), or animals captured in the wild, or animals captured in the wild from certain regions of the world, including regions within the United States (e.g., prairie dogs in the United States due to their potential to carry plague or tularemia); or*

Requiring health certifications and subsequent quarantine and health examination and/or testing prior to import *or domestic distribution of certain categories of animals; or*

Requiring assessments of potential disease risks prior to import *or domestic distribution of certain categories of animals, with the imposition of conditions or restrictions depending on the level of risk presented.*

To reiterate CDC's pre-import powers: it can issue **broad categorical bans,** require **comprehensive health measures** and/or require **disease risk assessments**. Since issuing the above statement in 2003, however, CDC has not exercised any of those broad powers, other than issuing several orders aimed at limiting bird imports that may carry avian influenza (see Chapter 3 and Appendix C).

The CDC has no mandate or authority to address pathogens that are not human health risks. It could not require, for example, screening of proposed imports for disease threats to native wildlife alone. Again, however, as discussed in Chapter 3, a major proportion of infectious diseases are shared between wildlife and humans.

Summary of regulatory responsibilities

To summarize, the primary relevant regulatory laws give authority to:

- FWS to prohibit specified "injurious" animals;
- APHIS, allowing, but not requiring, it to regulate any animal that is a pest or disease carrier threatening farmed livestock or any plant; and
- CDC, allowing, but not requiring, it to regulate any animal posing a human disease risk.

The nature of the regulatory authorities of these agencies as implemented is summarized in Table 11.

FWS's power to prohibit injurious species is reactive and slow. For APHIS, with respect to the livestock and plant risks within its jurisdiction, its authority is broad and capable of fairly rapid implementation. Similarly, for CDC and the human health risks under its power, as detailed above, its authority is potentially broad and capable of quick implementation. However, CDC has typically wielded its power reactively.

Agency Effectiveness and Potentially Risky Imports, 2000-2004

The 2,241 identified, non-native, imported animal species risk screened for this report include 302 for which Defenders found evidence indicating the species may meet the basic criteria for regulation by one or more of the three agencies (see Table 10, Table 7 and Appendix B). In other words, FWS, APHIS and/or CDC would have primary authority at least to make a decision on whether or not to regulate these species. Table 11 summarizes how the agencies have actually addressed these risks. (In considering the total annotations in Table 11, remember that some imported species were annotated for two or even three separate risk categories [see Table 7]). Also note that all imported species that were subject to an agency's import prohibition or restriction from 2000 to 2004 were risk-annotated on that basis [see Appendix B].)

FWS

The small number of Lacey Act-listed injurious taxa, about 35 species and genera, can be compared to the total of 309 risk annotations in Table 11 for the imported species identified as potentially invasive and/or that presented disease risks to nonlivestock animals (see Chapter 1, Table 7). These 309 annotations include none for livestock disease risks, plant pest/disease risks or known human disease risks. That is, all of the species associated with these annotations potentially would fall to FWS to regulate under its "backstop" injurious species authority. In comparison, FWS regulated only 18 of those species that actually were imported during 2000-2004 as injurious species (Table 11).

There is an obvious reason why so few species are regulated under the Lacey Act. This law requires a tedious administrative rulemaking procedure; it now typically takes at least four years for FWS to consider whether to add a single new injurious species.[98] Only two new listings have been added since 1991, a remarkably low number given the high number of potentially risky species imported. It took FWS seven years to approve one of the two taxa added, the brushtail possum, *Trichosurus vulpecula*. The other new listing, for two genera of snakehead fish (*Channa* spp. and *Parachanna* spp.), took only a few months but came well after these fish had invaded and begun to spread beyond the possibility of eradication.

In a detailed study, Fowler et al. assessed the Lacey Act's effectiveness in keeping out injurious imports. Their key

Table 11. Results of Coarse Risk Screening Relative to Federal Authority for Identified Non-native Species Imported 2000-2004

Agency/basic regulatory authority	Nature of authority as implemented	Number of risk annotations for imported species under the agency's authority*	Number of imported species actually regulated under the agency's authority**	Number of imported species the agency regulated for the first time during 2000-2004
FWS/invasive and/or injurious species, including disease risks for nonlivestock animals	Reactive authority, reactively implemented; slow decisions	309 annotations***	18 regulated species	5 of the 18 regulated species****
APHIS/disease risks and pests of livestock and plants	Potentially proactive authority, but reactively implemented; relatively rapid decisions	7 annotations	5 regulated species	3 of the 5 regulated species
CDC/human disease risks	Potentially proactive authority, but reactively implemented; relatively rapid decisions	54 annotations	11 regulated species	11 of the 11 regulated species
TOTAL		**370 annotations**	**34 regulated species**	**19 of the 34 regulated species**

Source: Table 7 and Appendix B

*Some species were annotated for two or, in some cases, three separate risk categories in Table 7.

**This number is based on the regulatory situation at the end of 2004, i.e., after any species were added to regulated lists during 2000-2004.

***This is the total from Table 7 of species annotated for Invasive Risk and/or Nonlivestock Animal Disease Risk, i.e., animal diseases not under APHIS's authority.

****Some of the FWS bans were imposed at the genus level, taking in several imported species.

findings (citations omitted):[99]

[O]ver half of listed taxa were already present in the U.S. when listed and, most taxa already established in the wild continued to spread after listing. Currently, five taxa are involved in the listing process. Mean time for a petitioned listing has increased to over four years, and only one taxon has been added by petition in the last decade. If the goals of the provision are to be accomplished in the face of increasing international trade in live organisms, then revision or replacement of the provision is required… Few knowledgeable observers would doubt that a great many more taxa—hundreds if not thousands of taxa, including pathogens—are "injurious or potentially injurious to the… survival of the wildlife or wildlife resources of the United States…" and should thus be prohibited entry under the Lacey Act's blacklist approach.

While the statute as implemented plainly is not effective given the magnitude of the import trade, Lacey Act listings are not entirely fruitless. They may have served to block or slow a small number of potential infestations. However, other rapid invaders such as the zebra mussel (*Dreissena polymorpha*) and mitten crab (*Eriocher* spp.) were so established and difficult to eradicate at the time of their FWS listings that they continue to spread on their own or via inadvertent human actions, such as moving contaminated boats into uncontaminated waters.

The slowness and ineffectiveness of the Lacey Act process certainly can be attributed to some extent to the lack of resources devoted to it. The FWS division in charge of injurious species consisted of only one and one-quarter full-time-equivalent employees in mid-2007.[100] This staff handles pending proposals and does not actively "screen" for suitable new candidates to add.

APHIS

The major part of APHIS's livestock and plant pest prevention efforts aim at *unintentionally* imported pests, almost entirely invertebrates and microorganisms. Its effectiveness at achieving this aim has been assessed by several bodies but, as previously stated, unintentional imports are outside the scope of this report.

Only seven annotations from the intentionally imported species lists present preliminary evidence of posing livestock disease risks and none reflects preliminary evidence of being a plant pest or plant disease risk (Table 11). APHIS regulates five of the imported species under the AHPA as livestock disease risks. This suggests very few species in these risk categories are being intentionally imported and that, within its narrow jurisdiction, APHIS is doing a relatively good job of keeping risky animals out of the import trade. Therefore, APHIS's role is not further scrutinized in this report.

CDC

An initially notable fact is that all 11 of the imported species that CDC has ever banned outright from further import, were banned during the period studied for this report, 2000 to 2004 (Table 11). The CDC banned six African rodent species in 2003 to block monkeypox and five civet cat species in 2004 to block SARS. This total of 11 banned species represents less than one quarter of the 54 annotations for human disease risk among non-native species on the import list.

Chapter 3 presented a detailed critique of the dangers of the current regulatory approach to protecting human and animal health. Others have described the international pet import trade as "a major chink in the USA public health armor."[101] The National Academy of Sciences' 2005 report, *Animal Health at the Crossroads*, called it a "gap":[102]

The current patchwork of federal policies and agencies with limited or ill-defined jurisdiction for the import, sale, and movement of exotic and wild-caught companion animals [the report's term for pets] and *zoo specimens is a significant gap in preventing and rapidly detecting emergent diseases.*

Similar concerns were expressed in a 2003 joint statement of the National Association of State Public Health Veterinarians and the Council of State and Territorial Epidemiologists.[103] In their official response to the monkeypox outbreak, they urged that:

…the recently instituted federal ban on the importation and movement of African rodents and prairie dogs be expanded to restrict the importation, exportation, and movement of all exotic wildlife.

In short, these key state and territorial officials charged with responding to disease outbreaks to preserve public health called for a vast expansion of the CDC's import restrictions to address all non-native animals.

In 2003, the CDC itself offered a similar opinion, stating that the monkeypox outbreak:

…highlights the public health threat posed by importation, for commercial purposes, of exotic pets into the United States.... The Institute of Medicine recently highlighted the role of international travel and commerce in the emergence of infectious diseases through the dissemination of pathogens and their vectors throughout the world. CDC and other federal agencies, in collaboration with state and local health departments and professional organizations, are developing long-term strategies to coordinate the control of importation, exportation, interstate trade, and intrastate sale of exotic and native wild animals.[104]

Yet, the agency has not followed through, having taken no discernible major, long-term steps since 2003 toward controlling the animal trade. The problem is not that CDC lacks adequate statutory authority, as is true for the FWS under the weak Lacey Act. Rather, CDC has not wielded its regulatory power aggressively, despite openly acknowledging that it could. It has stood by and allowed disease risks to freely enter the United States with neither species-by-species screening nor comprehensive testing and quarantines (Chapter 3).

Perhaps CDC's regulatory failings stem

from institutional problems within its bureau that regulates zoonotic diseases. According to news reports:[105]

Employees from the National Center for Zoonotic, Vector-Borne and Enteric Diseases [ZVED] *at CDC have raised concerns about "very serious issues" with the agency that have affected their ability to perform their jobs, according to an internal memo obtained by the Atlanta Journal-Constitution. According to the Journal-Constitution, the memo represents "the latest documentation of serious, ongoing problems at the public health agency." The memo, written last month* [December 2006] *by ZVED Director Lonnie King, highlights the results of interviews with more than 100 CDC employees. According to the memo, CDC employees cited concerns about "dilution of our scientific capacities," a lack of resources, and ineffective systems and leadership.*

With alarming animal-transmitted diseases emerging, improvements are clearly needed—and could be a matter of life or death.

Through the Broken Screens

The coarse-mesh risk screening summarized in Table 11 reveals 309 risk annotations for potentially "injurious" or invasive species that would fall to the FWS to regulate, and 54 annotations for potential human disease risks that would fall to the CDC, with several species in Appendix B presenting both categories of risk (see Table 7). These add up to 363 risk annotations (not counting APHIS-related species, which, as noted above, are not further considered in this report.) Except for the 29 total species on the import list that now have a FWS or CDC regulatory prohibition in place (see Table 11), there is no indication that any of the other imported species associated with these 363 risk annotations have ever gone through any screening or other analysis by FWS or CDC to determine if the risks they may pose are acceptable or not. The only other existing protection is for the limited numbers of disease-risk species, mostly birds, that are subject to quarantines and some limited bans aimed at avian influenza. **On the whole, it appears clear that the FWS and CDC regulatory statutes as implemented provide the United States a very low level of protection from potentially invasive/injurious species and species that pose infectious disease risks to humans and nonlivestock animals.**

The agencies themselves recognize the weakness of the federal regulatory scheme as far as not conducting proactive analyses. Each of the relevant cabinet agencies—DOI, USDA, and DHHS endorsed the National Invasive Species Council (NISC) Management Plan of 2001, which committed NISC, an interagency group created to ensure complementary, cost-efficient and effective federal action on invasive species, to develop comprehensive pre-import screening systems (see sidebar above). Yet, six years later NISC has failed to follow through with that task.

The next chapter sets forth recommendations for comprehensive policy reforms aimed at implementing proactive pre-import screening. FWS lacks needed statutory authority to implement such screening now. Only Congress can remedy that. In CDC's case the statutory authority is adequate, but the agency needs to undertake stronger regulatory initiatives.

NATIONAL INVASIVE SPECIES COUNCIL FAILS SCREEN TEST

Action Items 14 and 15 of the NISC Management Plan, *Meeting the Invasive Species Challenge,* include specific commitments–yet unfulfilled–to screen all imported animals.[95] Those action items call for:

> *...the development of a risk-based screening process for intentionally introduced species in a series of steps or phases. During the* ***first phase*** *a screening system for first-time intentional introductions will be developed, with different agencies taking the lead as appropriate for the different types of species. The screening system will then be modified by those same lead agencies during the* ***second phase*** *to deal with species already moving in the U.S.*

For animals, the plan calls for a "fair, feasible, and risk-based comprehensive screening system" aimed at:

> *Introduction of non-native land animals for any purpose (e.g., insects, zoo animals, terrestrial pets, or food animals) within the continental United States.* [and]
> *Introduction of non-native aquatic organisms for any purpose (e.g., fish or shellfish stocking, aquarium organisms, aquaculture stock, aquatic plants and biological control agents) within the continental United States.*

The plan says the first phase was to be complete by December 2003, the second phase by 2006. None of the screening systems is complete as of mid-2007 and there is no discernible date set for completion.[107] Even if they were completed, FWS lacks the statutory authority to implement proactive pre-import screening to keep out potentially harmful species, and the NISC plan neither grants FWS the needed authority nor clarifies the agency's need for it.

CHAPTER FIVE

MENDING THE SCREENS: RECOMMENDATIONS FOR REFORMING FEDERAL POLICY

No practical way exists to keep several classes of potentially harmful species out of the country under current federal law as implemented. For non-native species that are invasive, but not known threats to human health, livestock or plants, the Lacey Act injurious species process is the only available "backstop." That, however, requires notice and comment rulemaking taking three to four years on average to complete. No authority exists under the Lacey Act to keep imports of a species out of the country during the rulemaking process. This century-old backstop law, requiring cumbersome procedures to regulate just one species, is a classic example of a slow, reactive approach.

As documented in Chapter 4, major breaks exist in the protection afforded by the current laws as administered by the Fish and Wildlife Service (FWS) and the Centers for Disease Control (CDC). The system blocks relatively few of the most obvious threats and allows hundreds of potentially risky species into the country with no prior analysis. If they are released or escape to a wild or free-living state, these species can damage ecosystems, kill native animals and cause economic damage.

Regardless of whether it is legal in their state or not, people will release unwanted pets and aquarium specimens—witness the recent serious invasion of Burmese pythons in Everglades National Park. Federal aquatic invasives experts consider any non-native species used in aquaculture to be "virtually guaranteed of eventually escaping to the wild" (Chapter 2). Counting on states to block releases of harmful species to the wild if the federal government does not block their importation in the first place is a losing proposition.

Even where statutory grants of regulatory authority to the federal agencies are broad, such as CDC's power to regulate any species posing a human communicable disease risk, implementation has not been proactive by CDC's own admission (Chapter 4). In May 2006, CDC held a revealing public meeting, "Discussions Regarding Exotic Animal Importation, Sale, and Distribution."[108] Comments submitted by a variety of experts and agencies stated overwhelmingly that CDC's protections are inadequate to prevent further zoonotic disease outbreaks. Veterinarian Gregory A. Ledbetter, Administrator of the Division of Animal Industries, Idaho Department of Agriculture, succinctly summed up the need for improvement (emphasis in original):

> *The Idaho State Department of Agriculture supports a comprehensive system that would greatly restrict and ONLY allow the importation of any exotic plants and animals AFTER appropriate testing and quarantine. The AVMA* [American Veterinary Medical Association]*, CSTE* [Council of State and Territorial Epidemiologists]*, NASPHV* [National Association of State Public Health Veterinarians] *and others have been asking for this type of oversight for several years. I believe our citizens would be shocked to know that no federal agency has appropriate jurisdiction and responsibility for the safe importation of exotic plants and animals. We support an effort that will keep foreign animal and zoonotic diseases out of our country, our state, and our families.*

Similarly, in 2006 the Ecological Society of America (ESA), a group leading the way in science-based solutions to environmental problems, issued a detailed position paper on biological invasions that included the following statement[109] (emphasis added):

> [ESA] *recommends that the federal government, in cooperation with state and local governments, take the following…actions: (1) Use new information and practices to better manage commercial and other pathways to reduce the transport and release of potentially harmful species. (2)* ***Adopt new, quantitative procedures for risk analysis and apply them to every species proposed for importation into the country****.*

The Need for Reforms*

In short, the federal approach needs to change from allowing species to enter the country until they are shown to be harmful to the proactive approach of prohibiting their entry until they are shown to be acceptably safe. Getting to that approach will take the **invasive/injurious species policy reforms, health-related policy reforms** and **other reforms** discussed in this chapter. The industries and other stakeholders involved with animal imports should be constructively engaged to bring about the necessary changes.

One of the goals of this report is that Defenders' policy recommendations should reflect the most advanced science. The sidebar on page 31 offers state-of-the-art thinking on several vital questions raised by the ESA position paper excerpted above: How well can science predict potential invasiveness of a given novel, non-native animal species in the United States? How can federal regulators go beyond the coarse-mesh pre-import screening done for this report, particularly to address those species

*This chapter does not address the narrow categories of risk to domestic livestock or plants presented by the intentional animal import trade that fall under the authority of the Animal and Plant Health Inspection Service (APHIS). The analysis conducted for this report showed that these risks, while by no means eliminated, are the most comprehensively regulated of all comparable risks.

that do not present any prior indication of risk, either because they are entirely novel to the trade or, like many species, they simply have not been studied enough by scientists to assess their invasiveness? Can officials use quantitative procedures for previously unstudied animals in a regulatory system?

The impetus behind these questions is ESA's provocative recommendation to apply quantitative procedures to every species proposed for importation. Screening with no predictive modeling served here to identify 302 potentially risky species out of 2,241 imports needing more detailed risk analysis. Only 34 of those 302 species were actually regulated for invasiveness or disease risk by the FWS, CDC or APHIS during 2000-2004 (Table 11). The 1,939 species (2,241 minus 302) that were not caught by the four-month-long limited research effort undertaken for this report should *not* be assumed safe. Future regulatory officials will need to consider applying quantitative procedures to them. As the sidebar, opposite, indicates, scientists have developed reasonably accurate tools to do this for some taxonomic groups already and, with additional support, could expand these tools.

Recommendations for Reforms

Invasive/injurious species policy reforms

1. Pass new legislation that clearly directs FWS, CDC and other federal agencies to follow a more risk-averse national standard for animal imports.

In 1993, an Office of Technology Assessment (OTA) study on harmful invasive species identified the need to adopt a more stringent and uniform national policy.[121] Fourteen years later, the only progress has come from a 1999 Executive Order by President Clinton and the National Invasive Species Council Management Plan of 2001.[122] Both of these are unenforceable, lack regulatory effect and are routinely ignored by agencies. To have the force of law, Congress must act to adopt a national standard.

Defenders recommends the following language for this standard:

THE SCIENCE OF PREDICTING ANIMAL INVASIONS*

The Ecological Society of America's comprehensive 2006 position paper on biological invasions recommends application of pre-import screening and risk analysis methods to all species proposed for import to prevent additional invasions.[110] To be most effective, these methods must be repeatable, scientifically supportable, time and cost effective and usable across all agencies.[111] The challenge for researchers, managers, and government agencies is to create tools that identify potential invaders without unduly and unfairly restricting imports of all species.[112]

A basis for screening and risk analysis is the use of models that accurately predict species invasiveness. Recognition that the key factors in a particular species' progression through the invasion process may vary among taxonomic groups and among the pathways and stages of the process facilitates the construction of these models.[113] Key information used to construct predictive models has included propagule pressure (the number of individuals available or introduced per introduction event), species characteristics (life and invasion history) and the specific environmental requirements (e.g., climate matching) that correlate to successful passage through each stage of an invasion.[114]

Information sources and frameworks for these models vary—from the use of qualitative ranking systems based on scientific literature and expert opinion, to quantitative models using single or multivariate predictor variables, to hybrids between qualitative and quantitative models. Researchers have validated the accuracy of several models by checking their invasiveness predictions against both successful and failed species invasions in reality.[115]

The utility of models depends on their accuracy (the proportion of species correctly classified as invasive) and reliability (the rate of incorrectly classified species).[116] Over time, the accuracy of models in identifying those species that could become invasive has increased to as much as 80 to 95 percent. Researchers have applied them to several taxonomic groups within the United States, i.e., plants,[117] mussels[118] and fish.[119]

In addition to a quantitative framework, a risk analysis tool is needed that applies to the actual animals that the United States is importing. Such a model would incorporate trade-related characteristics for each species, i.e., quantity imported and proportion wild-caught,[120] and other life and natural history characteristics to identify the most informative characteristics for each stage of a potential invasion process. A short decision tree based on those key characteristics could be used to create a preliminary list of species that should be provisionally (temporarily) prohibited from entry. A more thorough risk assessment then could be done for these species using additional characteristics and climate-matching tools.

The efficient prevention of invasions by harmful species through the live animal trade also requires more open dialogue among researchers in academia, industry and government, and the policy makers and regulatory agency officials whom their research can inform. No single entity can fully address all the potential risks that the broad variety of thousands of imported animal species can pose. Increased collaboration and funding are vital to creating the best scientific tools to prevent future invasions.

*Contributed by Christina Romagosa, an Auburn University Ph.D. candidate whose research addresses this and related topics.

Federal agencies shall only allow imports and interstate commerce in non-native animals that have been assessed by a responsible federal official and determined to pose a low likelihood of causing harm to the environment, the economy, public health, or animal or plant health in the United States.

2. Amend the Lacey Act to direct FWS to conduct detailed pre-import screening of each animal species proposed for importing and give FWS authority to provisionally prohibit any species for which inadequate scientific information is available.

In their authoritative paper, Fowler et al recently analyzed the Lacey Act's effectiveness and concluded the statute:[123]

…should be revised or new legislation enacted to provide a time limit on the listing process, emergency measures to temporarily prohibit importation and transport of species during the listing process, mandatory risk assessments for all species proposed for importation to determine whether such species should be added to the injurious species list, and prohibit possession of listed species….. If the U.S. is to reduce the probability of future damages from invasive animal species, revision or replacement of the Lacey Act injurious wildlife provision is essential. The contemporary threat of invasive species has far outstripped current authority and practices under the Lacey Act injurious wildlife provision.

The best way to achieve these "mandatory risk assessments for all species proposed for importation" is to amend the Lacey Act to replace the current injurious species provision with a precautionary three-list ("clean/dirty/gray") approach implemented with FWS as the lead agency. Under this approach all species proposed for import are classified as either: 1) allowed (clean list); 2) nonprovisionally prohibited (dirty or injurious list); or 3) provisionally prohibited pending further information (gray list).[124] More reliable and faster tools now exist for assessing the myriad risks associated with unregulated animal imports. These tools draw on the growing scientific databases on invasive species, such as the Invasive Species Specialists Group's Global Registry of Invasive Species (GRIS) database, and also draw on expert opinion networks, decision trees and predictive models. With these tools, the three-list approach can be taken, as it has been, with variations, in Australia, New Zealand and elsewhere, without unduly restricting trade.

Say, for example, a company wants to import a previously uncategorized animal, "species x," into the United States. If this species, after a risk assessment by FWS and/or cooperating agency scientists, meets the U.S.-acceptable level of risk, it is placed on the clean list and allowed to be imported. Note that the "acceptable level of risk" should be clearly expressed as stated in Recommendation 1: "a low likelihood of causing harm to the environment, the economy, public health, or animal or plant health in the United States."

If, after a detailed assessment, species x fails to meet that standard, it is placed on the dirty/injurious list and is prohibited non-provisionally, i.e., permanently, unless or until new scientific information changes the risk finding. Various gradations of allowance and prohibition may be adopted, including exemptions for common, obviously safe species; exemptions for research and display; quarantine requirements; emergency provisions; and processes for amending lists based on new information.

If significant information about the risk, if any, associated with a species is missing, then uncertainty exists and it goes on the gray list. Gray-listed species are provisionally prohibited pending receipt of the information needed to conduct a full risk assessment adequate to satisfy FWS and cooperating agencies.

Importantly, this precautionary proposal is likely to generate net economic

CRAFTING NEW LEGISLATION: CHECKLIST FOR SUCCESS

New legislation to modify the Lacey Act approach should be crafted to meet the following criteria:

- ☑ The purpose of the new legislation is clearly to serve a more risk-averse national standard.
- ☑ The new approach is modeled after successful efforts in other nations.
- ☑ The process includes outreach to affected businesses and other stakeholders and addresses any animal welfare impacts and other foreseeable concerns.
- ☑ The new law complies with international laws on trade, biodiversity and health and does not unnecessarily preempt existing federal and state laws.
- ☑ The new law includes:
  - Sufficient phase-in time of two to three years.
  - Coordinated interagency decision making on animal imports.
  - Exemptions for importing common, obviously safe, species and animals for qualified zoos, research facilities and similar institutions.
  - Limited "grandfathering" for prior owners of later-prohibited species.
  - Adequate sanctions to deter illegal behavior such as smuggling.
  - Regular evaluations of the effectiveness of the procedure.
  - Increased funding for research and development of import-screening tools.
  - User fees that will eventually make the new system largely self-supporting.

benefits for the nation. Keller et al. examined the economic costs and benefits of an existing, similar, pre-import screening system for plants, Australia's well-known Weed Risk Assessment system.[125] Their economic study covered non-native species proposed for importation and use in the ornamental plant trade. Species likely to cause unintended economic or environmental damage in Australia are prohibited, while species yielding net benefits are approved for the country's plant trade. Keller et al. found that Australia's weed-screening effort paid for itself by reducing economic damage in just over 10 years and would result in as much as $1.8 billion in savings over 50 years. The researchers suggested that screening for animals would be even more likely to a yield a net beneficial result than screening for plants.

Some have suggested a blanket exemption from pre-import screening and regulation for *all* species "in trade" prior to the enactment of a new regulatory approach, i.e., screen only novel species added to the trade after a certain date.[126] Based on the import data in Chapter 1, more than 2,000 non-native species are currently "in trade." Granting all of them an exemption from further screening and regulation makes no sense. As discussed in Chapter 2, many other risky "snakehead-like" species are in trade that are not established in the wild in this country *yet*, but are more likely to become established if they continue to be imported widely. This "lag effect" is a biological reality that cannot be ignored. It would be a waste of effort to give the thousands of species already in trade an official green light by setting up a screening system aimed at only the handful of novel species added to the import list each year. Such a system certainly would not meet the more risk-averse standard stressed in Recommendation 1.

3. Promptly analyze the risks of continuing to import species identified as potentially risky.

The coarse-mesh risk screening conducted for this report (Appendices A and B; Tables 6 and 7) should not go to waste. The 302 potentially risky species identified should immediately be assessed in finer detail to determine whether they should be prohibited or restricted from further commerce into the country (about 34 of those species are already blocked to some extent, Table 11). For those identified as livestock or human disease risks, APHIS and the CDC, respectively, have adequate authority now to issue prompt regulatory orders affecting their future importation. FWS needs either the new statutory authority urged in Recommendation 2 or a dramatically enhanced program of listing prohibited species within its current Lacey Act authority. (The latter seems unrealistic given the low level of resources FWS devotes to the Lacey Act listings and the slow pace at which it has moved on these matters over the last decades.)

The obvious exceptions to this recommendation are species that are so accepted or common and widespread in established populations in the United States that further regulation would be futile. Examples from Appendix B include *Carassius auratus* (goldfish) and *Mus musculus* (mouse). The same exception applies to species that are imported in small numbers for limited uses, and/or present minor invasiveness and/or disease risks that are readily manageable. Examples include *Camelus dromedarus* (dromedary camel) and *Panthera tigris* (tiger).

4. Aggressively implement the requirement that full species identification accompany every animal shipment and make that identification information public.

The law on species identification is already clear under 50 CFR 14.53:

> *b) Refusal of clearance. Any Service officer may refuse clearance of imported or exported wildlife… when …*
> *(2) The correct identity and country of origin of the wildlife has not been established (in such cases, the burden is upon the owner, importer, exporter, consignor, or consignee to establish such identity by scientific name to the species level…)*

Quantitative data are lacking, but it appears importers sometimes ignore their "burden" under this regulation. Shipments of animals that are not identified by scientific names or are misidentified have arrived and been cleared by FWS port inspectors.[127] The species identification requirement for imports should be more aggressively enforced as it was under a 1998 law in New Zealand, reportedly making "significant improvements" to that country's prevention and quarantine programs.[128]

Broadly announcing the identification requirement to U.S. importers and strictly enforcing it with hefty monetary penalties for violations would likely ensure compliance. Allowances can be made for taxonomic changes and uncertainty, honest mistakes, typographical errors, humane handling of rejected shipments and other special considerations. However, a substantial disincentive must be put in place to discourage intentional or sloppy misidentification, an apparently regular occurrence.[129]

The identification information collected by FWS should also be accurate and available to the public in searchable databases on the Internet. The current haphazard system of data collection under FWS's Law Enforcement Management Information System (LEMIS) uses generic or multiple species codes—not species-specific codes—and requires a Freedom of Information Act (FOIA) request for public release. The absence of accurate *public* identification of shipments to the species level in the LEMIS data is a major impediment to a risk-screening program (see Chapter 1). Neither the public nor outside scientific experts are able to obtain a full, current picture of the trade. Individual species codes must be created and entered into a database easily accessed by the public. Increasing funding for the FWS Office of Law Enforcement (OLE) and raising user fees for importers, discussed in Recommendation 10 below, would defray the costs of putting these data online.

*Health-related policy reforms**

5. Immediately address the threat of avian influenza by enforcing the 30-day quarantine required for all bird imports and testing every bird.

CDC and other border-protection agencies must fully recognize that the health and economic risks of avian influenza are grave and that they are not doing enough to block the immediate threat of this virus entering the United States. For all bird imports, the 30-day quarantine should be enforced rigidly and every bird should be mandatorily tested for avian influenza. More funds should be made available, in particular via a fee or surcharge on bird import shipments, to pay for random testing of imports for infectious diseases beyond those already tested such as Newcastle's disease and psittacosis.

6. Coordinate and strengthen the federal government's role in overseeing and regulating health risks associated with live animal imports.

A CBS News report examining the coverage of animal imports noted the system imposed "little or no screening for disease," stating:[130]

America's defenses are a bureaucratic nightmare. Laws are outdated and no single agency is responsible for pre-empting the next outbreak.

Indeed, no single agency bears responsibility for leading the nation's response to animal-transmitted disease threats. Congress should authorize and fund a new office to coordinate multi-agency efforts to research, prevent, control and eradicate infectious diseases linked to animal imports (including imported U.S.-native species). This office could be within the Department of the Interior, which already houses the U.S. Geological Survey (USGS) National Wildlife Health Center, or in the U.S. Department of Agriculture (USDA), which oversees the National Wildlife Research Center.

The need for coordination is vividly illustrated by the fact that more than 200 government offices, hundreds of state and local health agencies and seven federal cabinet agencies were involved in controlling the outbreaks of monkeypox virus, West Nile virus, Lyme disease and chronic wasting disease in the United States.[131] Disconnection exists among the organizations concerned with the health of 1) humans (CDC, the National Institute of Health, state public health agencies), 2) domesticated animals (APHIS) and 3) native wildlife (FWS and USGS). Because the majority of infectious diseases are shared among multiple hosts in these three categories, leadership is vital to ensure agencies with differing missions can function quickly and effectively across "turf" boundaries. For example, FWS port inspectors must have clearer authority to reject or safely dispose of shipments of sick and dying animals and be better trained and equipped to do so.

In recent years, the National Animal Health Laboratory Network was developed to examine routine and specific-risk samples for exotic animal diseases. The National Animal Health Surveillance System was created to improve early detection and global surveillance of exotic animal diseases by integrating existing animal-health monitoring programs and surveillance activities into a comprehensive system. The Food and Drug Administration (FDA), CDC and USDA formed a working group tasked with coordinating human and animal disease monitoring. This led to an increase in staff at CDC and USDA to: 1) identify necessary elements and essential partners; 2) develop a system of communication and triggers for action; 3) divide the workload to maximize efficiency and identify roles and responsibilities; and 4) incorporate animal health surveillance into existing systems.[132] Such working groups are critical to prevent future disease epidemics resulting from animal imports. However, their existence should be formalized and strengthened by the agencies and by Congress.

7. Appropriate more funds for research.

An increase in federal funds is critical to support cross-disciplinary research on: 1) forces that promote the evolution of infectious diseases when they are introduced to new environments; 2) the dynamics of disease spread between unique host groups such as humans, domesticated animals and native wildlife; 3) the spread of infectious agents along established trade routes; and 4) the current degree of risk of introduction for

THE INTERNATIONAL CONTEXT

Understanding the international context for the recommendations in this report is vital to ensuring that Congress and the agencies, as they seek to reform U.S. law, do not violate international trade laws to which the United States is a party. Defenders analyzed this context for *International Law on Precautionary Approaches to National Regulation of Live Animal Imports*, a white paper (Appendix A, Item 10). The paper also discusses how the ISSG GRIS database, which was launched as a publicly available prototype database in conjunction with this report and now contains more than 16,000 species entries, can serve as a tool to aid future international decisionmaking on invasive species risks. Further, the white paper discusses the role of international animal health authorities in tackling this global problem.

*These recommendations were contributed by the Consortium on Conservation Medicine, primarily by Katherine F. Smith, Ph.D.

exotic diseases of the most immediate high-priority concern such as SARS and H5N1 avian influenza.

Deploying a predictive "emerging disease hotspot" approach to focus resources on pre-border surveillance would greatly benefit future surveillance and control strategies.[133] For example, research has revealed that closing the Hong Kong poultry markets for one day per month reduced the rate of H9N2 avian influenza virus in market birds.[134] Yet, little comparable research has been conducted on disease mitigation for other facets of the global animal trade.

Innovative, cross-disciplinary research would provide valuable information for the new pre-import screening and risk assessment processes for non-native species proposed in Recommendations 2 and 3. Further, when disease outbreaks occur, the research products recommended here would directly enhance the necessary response, surveillance, detection and eradication programs.

8. Implement the post-import recommendations adopted by the National Association of State Public Health Veterinarians (NASPHV) and the Council of State and Territorial Epidemiologists (CSTE).

A joint position statement adopted by the NASPHV and CSTE recommended that a high-level working group of federal and state agency officials be convened to make recommendations not only on the issue of regulating imports, but also on several *post-import* issues surrounding non-native animals.[135] They recommended:

- Developing methods to monitor and maintain ownership and movement data on all imported wildlife and to enforce institutional responsibility in maintaining exotic wildlife so that they are not redistributed for private ownership and recreational purposes.
- Monitoring and assuring legitimacy and safety of interstate movements and redistributions of exotic wildlife.
- Supporting state and local public health infrastructure in identification and response to public health threats from diseases introduced and transmitted from exotic wildlife.
- Working with zoos and research institutions to develop policies to reduce risks of introduction of disease into their collections.
- Collecting comprehensive data on the distribution channels for exotic wildlife in the pet trade
- Developing a national action plan to restrict the redistribution and translocation of all exotic wildlife to legitimate scientific and exhibition purposes.

The CDC should convene the recommended high-level working group of federal and state agency officials and also include academic, industry, environmental and health experts to flesh out and implement these NASPHV and CSTE recommendations.

Other necessary reforms

9. Increase funding and staffing for FWS port inspectors.

The FWS Office of Law Enforcement (OLE), known as "The Thin Green Line," is the agency charged with inspecting animal shipments at the ports of entry, ensuring compliance with import laws and regulations and enforcing the Lacey Act injurious species provisions and other laws. Its vital port-inspection function is overstretched and resource-deprived as evidenced by its incomplete inspection rates for animal shipments and the shipments allowed in without the required full species identification (Chapter 1 and Recommendation 4).

For the four fiscal years 2002 through 2005, the total number of shipments of live animals and animal parts and products inspected by OLE increased 46 percent to a total of 171,874 shipments.[136] The number of port inspectors increased only 15 percent to a total of 105 inspectors for the entire country. Thus the workload—the average number of shipments inspected annually by each inspector—significantly increased, rising 27 percent from 2002 to 2005, to 1,632 shipments per year. These trends establish OLE's reduced capacity to be attentive to each live animal shipment.

Recommendations 1 through 3, calling for enhanced pre-import screening led by the FWS, will be ineffective unless OLE can fully and properly inspect shipments and enforce the laws. An improved OLE can better tackle all aspects of the trade in live animals and animal parts, including enforcing conservation laws and treaties, stopping smuggling, addressing the massive increase in illegal sales on the Internet and assisting states in law enforcement.

Congress must increase the appropriations to OLE to enable it to do its job better. Congress also should authorize higher user fees for inspections of animal shipments. The fees have not been increased since 1996 and now cover less than half of OLE's cost of inspections.[126] Federal taxpayers are "paying the freight" that the animal importers should be paying themselves.

10. Implement an application fee system to pay for the bulk of the cost of pre-import screening.

In addition to the FWS OLE user fee for inspecting shipments at the ports, importers should pay the bulk of the cost of the pre-import screening called for in this report with application fees charged for approvals of proposed animal imports. Congress should give FWS the authority that it currently lacks to charge such fees.

Fee costs can be passed on to the animal buyers, the ultimate beneficiaries of this trade. Tropical fish, pet snakes and the majority of imported animals are nonessential "luxury" items. The small price increase resulting from a pre-import application fee likely would have little effect on the industry as a whole.[138]

The economic impact of the application fee would be miniscule relative to the huge value of the animal import trade (see Chapter 1, Tables 4 and 5). The modest cost of the research done for this report (less than $30,000 and about four months

LORI OBERHOFER/NATIONAL PARK SERVICE

A National Park Service biologist examines a 10-foot, 3-inch Burmese python captured on an access road to Everglades National Park. The pythons–one of the world's largest snakes and a favorite of the international pet trade–are released in the area by disenchanted owners.

of staff time to conduct preliminary risk screening for *all* the fully identified species in the trade) can be compared to the declared wholesale value of these products at their ports of entry. Over the five years (2000-2004) assessed here, that value was **more than one-half billion dollars**. There is no good reason for taxpayers to fully subsidize the cost of stricter screening.

11. Include the animal import industry and other stakeholders in policy solutions.

The breadth and experience of the U.S. pet industry and wild animal trade create a key opportunity to implement programs to prevent the import and spread of invasive species and animal diseases. For example, the Pet Industry Joint Advisory Council (PIJAC) is the world's largest pet trade association. PIJAC works with other pet trade associations and like-minded organizations throughout the world to ensure consideration of the industry's interests in federal and international affairs.

Effective collaboration among industry groups such as PIJAC, regulatory agencies, researchers, environmentalists, public health experts and other stakeholders could prove critical in stopping harmful imports.

Such collaboration also can help mitigate the impact of future policies on the U.S. pet industry. As the fields of wildlife conservation, public health and veterinary health strive to better incorporate the social sciences and engage stakeholders in conservation and health initiatives, the time is ripe for working with the pet trade and other stakeholders to develop solutions.

Conclusion

Mending the broken screens that allow harmful species into the United States is relatively simple because there are only a few dozen ports, airports and border crossings where legal animal imports arrive. The federal government could readily impose stricter controls over these entry points and keep invasive and injurious species out. Indeed, compared to the other major pathways for harmful animal introductions into the United States, such as ship ballast water and packing crates carrying potentially invasive species, intentional legal animal imports are the easiest to regulate effectively—if Congress and the administration choose to do so and the federal agencies are fully committed.

Whatever the roots of our past policies, it is time to wake up to the risks and to accept the challenges. The 11 recommendations in this chapter, backed by the quantitative, scientific information presented in this report, show the way. The health of our nation's ecosystems—and our own well-being—demand that we act accordingly.

APPENDIX A

DEFENDERS OF WILDLIFE ONLINE DATA ON IMPORTED SPECIES AND PRELIMINARY RISK SCREENING

For additional information, Defenders' Web page, www.defenders.org/animalimports, features links to the 10 items listed below:

Item 1) Identified Non-native Animal Species Imported into the U.S., by Taxa, 2000-2004. These are the non-native species identified in the LEMIS records to the species level, arranged by major taxonomic group.

Item 2) Alphabetical List of All Identified Non-native Animals Imported into the U.S., 2000-2004. This is an alphabetized master list of all the non-native species.

Item 3) Identified U.S. Native Animal Imports, by Taxa, 2000-2004. These are the species native to the United States, arranged by major taxonomic group.

Item 4) Partially Identified (Genus only) Animal Imports to the U.S, by Taxa, Only for Genera Not Represented on the Lists of Fully Identified Species, 2000-2004. These are genus records for imports that lacked identification to the species level. They do not duplicate genera included on the above species lists; the genera may include both U.S. native and non-native species.

Item 5) Preliminary Invasiveness and Disease Risk Annotations for Identified Non-native Animal Species Imported into the United States, 2000-2004. This table provides all the risk-annotated species on the non-native species import lists, grouped by taxa, and includes a key at the end to common abbreviations. This list is also printed in full in this report as Appendix B.

Item 6) Global Register on Invasive Species (GRIS) Full Annotations for 191 Taxa Identified as Invasive or Potentially Invasive. This is the source for all of the risk annotations in the table in Item 5), above, labeled with the abbreviation "GRIS" that came from the database search conducted by the IUCN ISSG, on contract to Defenders for this report.

Item 7) Comparing U.S. Animal Import List to Global Invasive Species Data. This is the full March 2007 Consultant's Report by the IUCN ISSG to Defenders describing the GRIS database search with respect to animal imports into the U.S.

Item 8) Countries Exporting Live Animals to the United States, 2000-2004. This lists each of the source countries for U.S. imports.

Item 9) White Paper: *Economic Impacts of Live Animal Imports to the United States*. This paper by Defenders' natural resource economist, Timm Kroeger, Ph.D., covers the economic impacts of the live wild animal import trade and how to account for them.

Item 10) White Paper: *International Law on Precautionary Approaches to National Regulation of Live Animal Imports.* This paper by Defenders' director of international conservation, Peter T. Jenkins, assesses the role of international law, particularly the World Trade Organization's Sanitary and Phytosanitary Agreement, the Convention on Biological Diversity and the World Organization for Animal Health, as a backdrop to the needed U.S. import policy reforms.

APPENDIX B

PRELIMINARY INVASIVENESS AND DISEASE RISK ANNOTATIONS FOR IDENTIFIED NON-NATIVE ANIMAL SPECIES IMPORTED TO THE UNITED STATES, 2000-2004

NOTES:
- Key to common abbreviations in annotations appears at end of table (page 47).
- Annotations do not include all available risk information and are not definitive as to risks in the United States.
- Annotations are for invasiveness risk unless a disease risk is noted.

Genus	Species	Common name and annotation
NON-NATIVE AMPHIBIANS		
Ambystoma	*mexicanum*	Mexican salamander, GRIS, amphib. disease, Molec. Ecol. 14:213-24
Atelopus	*varius*	Harlequin toad, amphib. disease, Proc. Nat. Acad. Sci. 95:9031-9036
Atelopus	*zeteki*	Golden frog, amphib. disease, www.calacademy.org/science_now/headline_science
Bombina	*variegate*	Yellow-bellied toad, GRIS
Dendrobates	*auratus*	Green and black dart-poison frog, NAS Impact; and amphib. disease, J. Vet. Diagnost. Invest. 11:194-199
Dendrobates	*azureus*	Blue dart frog, amphib. disease, J. Vet. Diagnostic Invest. 11:194-199
Dendrobates	*tinctorius*	Dyeing poison frog, amphib. disease, J. Vet. Diagnost. Invest. 11:194-199
Kaloula	*pulchra*	Asian painted frog, GRIS
Litoria	*aurea*	Green and golden bell frog, NAS Impact, GRIS
Litoria	*caerulea*	Great green treefrog, NAS Impact, GRIS; and amphib. disease, Proc. Nat Acad. Sci. 95:9031-9036
Ptychadena	*mascareniensis*	Mascarene grass frog, GRIS
Rana	*ridibunda*	Marsh frog, GRIS
Rana	*temporaria*	European or common frog, amphib. disease, Vet Record 137:72-3
TOTAL ANNOTATED NON-NATIVE AMPHIBIANS: 13 of 172 imported non-natives		
NON-NATIVE BIRDS		
Acridotheres	*tristis*	Indian/common mynah, 100 Worst, '91 OTA, GRIS; and disease USGS AI
Agapornis	*canus*	Grey-headed lovebird, GRIS
Agapornis	*fischeri*	Fischer's lovebird, GAE/Birdlife C, GRIS
Agapornis	*lilianae*	Lilian's lovebird, GRIS
Agapornis	*nigrigenis*	Black-cheeked lovebird, GRIS
Agapornis	*personatus*	Yellow-collared lovebird, GRIS
Agapornis	*pullarius*	Red-headed lovebird, GRIS
Agapornis	*roseicollis*	Rosy-faced/peach-faced lovebird, GRIS
Aix	*galericulata*	Mandarin duck, GAE/Birdlife C, GRIS
Alectoris	*chukar*	Chukar, GRIS; disease, USGS AI,

Genus	Species	Common name and annotation
Alopechen	*aegyptiacus*	Egyptian goose, GRIS
Amandina	*fasciata*	Cut-throat finch, GRIS
Amandava	*amandava*	Red munia, GAE/Birdlife C, GRIS
Amandava	*subflava*	Zebra waxbill, GRIS
Amazona	*aestiva*	Blue-fronted parrot, GRIS
Amazona	*amazonica*	Orange-winged parrot, GRIS
Amazona	*ochrocephala*	Yellow-crowned parrot, GRIS
Anas	*castanea*	Chestnut-breasted teal, disease, USGS AI
Anas	*falcata*	Puna teal, disease, USGS AI
Anas	*sibilatrix*	Chiloe wigeon, disease, USGS AI
Anodorhynchus	*hyachinthinus*	Hyacinth macaw, GRIS
Anser	*anser*	Greylag goose, GRIS
Anser	*cygnoides*	Swan goose, GAE/Birdlife E1, GRIS
Anser	*indicus*	Bar-headed goose, GAE/Birdlife C, GRIS; and disease USGS AI
Ara	*ararauna*	Blue and yellow macaw, GRIS
Ara	*macao*	Scarlet macaw, GRIS
Ara	*rubrogenys*	Red-fronted macaw, GRIS
Aratinga	*acuticaudata*	Blue-crowned (B-C) parakeet, B-C/sharp-tailed conure, GAE/Birdlife E1
Aratinga	*aurea*	Peach-fronted parakeet, GRIS
Aratinga	*auricapilla*	Golden-capped parakeet, GRIS
Aratinga	*erythrogenys*	Red-masked or cherry-headed conure, GAE/Birdlife E1
Aratinga	*jandaya*	Jandaya parakeet, GRIS
Aratinga	*mitrata*	Mitred conure, GAE/Birdlife E1
Aratinga	*pertinax*	Brown-throated conure, '91 OTA, GRIS
Aratinga	*solstitialils*	Sun parakeet, GRIS
Aythya	*fuligula*	Tufted duck, disease, USGS AI
Branta	*leucopsis*	Barnacle goose, GRIS
Branta	*ruficollis*	Red-breasted goose, disease, USGS AI
Brotogeris	*versicolurus*	Canary-winged parakeet, '91 OTA
Buteo	*buteo*	Buzzard, disease, USGS AI
Cacatua	*galerita*	Sulphur-crested cockatoo, GRIS
Cacatua	*sulphurea*	Yellow-crested cockatoo, GRIS
Carduelis	*carduelis*	European goldfinch, GRIS; and disease, USGS WNV
Carduelis	*chloris*	European greenfish, GRIS
Carduelis	*magellanica*	Hooded siskin, GRIS
Carduelis	*sinica*	Grey-capped greenfinch, GRIS
Carduelis	*spinus*	Eurasian siskin, GRIS

Genus	Species	Common name and annotation
Chrysolophus	*amherstiae*	Lady Amherst's pheasant, GAE/Birdlife C, GRIS
Chrysolophus	*pictus*	Golden pheasant, GAE/Birdlife C, GRIS
Coluba	*livia*	Rock dove, FL-FWC >10 yrs, est., GRIS; and disease USGS AI
Copsychus	*saularis*	Oriental magpie robin, disease, USGS AI
Coturnix	*japonica*	Japanese quail, GAE/Birdlife C, GRIS
Cyanoramphus	*auriceps*	Yellow-crowned parakeet, GRIS
Cyanoramphus	*novaezelandiae*	Red-fronted parakeet, GRIS
Cygnus	*atratus*	Black swan, GAE/Birdlife C, GRIS; and disease, USGS AI
Cygnus	*cygnus*	Whooper swan, disease, USGS AI
Cygnus	*melanocorypha*	Black-necked swan, disease, USGS AI
Cygnus	*olor*	Mute swan, '91 OTA, GRIS; and disease, USGS AI
Dromoaius	*novaehollandiae*	Emu, GRIS; and disease, USGS AI
Eos	*bornea*	Red lory, GRIS
Erythrura	*prasina*	Pin-tailed parrotfinch, GRIS
Erythrura	*psittacea*	Red-throated parrotfinch, GRIS
Erythrura	*tricolor*	Tricolored parrotfinch, GRIS
Estrilda	*caerulescens*	Lavender waxbill, GRIS
Estrilda	*melpoda*	Orange cheek waxbills, GAE/Birdlife E1, GRIS
Estrilda	*troglodytes*	Black-rumped waxbill, GAE/Birdlife E1, GRIS
Euplectes	*orix*	Red bishop, GRIS
Euschistospiza	*dybowskii*	Dybowski's twinspot, GRIS
Falco	*cherrug*	Saker falcon, disease, USGS AI
Falco	*tinnunculus*	Common kestrel, disease, USGS AI
Fringilla	*coelebs*	Chaffinch, GRIS
Gallicolumba	*jobiensis*	White-bibbed ground dove, GRIS
Gallus	*varius*	Green junglefowl, GRIS
Garrulax	*leucolophus*	White-crested laughingthrush, GRIS
Gracula	*religiosa*	Hill mynah, '91 OTA, FL-FWC; and disease, USGS AI
Hypargos	*niveoguttatus*	Peter's twinspot, GRIS
Lagonosticta	*senegala*	Red-billed firefinch, GRIS
Lagopus	*lagopus*	Willow grouse, GRIS
Lonchura	*castaneothorax*	Chesnut-breasted munia, GRIS
Lonchura	*cucullata*	Bronze munia, GRIS
Lonchura	*maja*	White-headed munia, GRIS
Lonchura	*malabarica*	Indian silverbill, GAE/Birdlife C, GRIS
Lonchura	*malacca*	Chestnut mannikin, '91 OTA , GRIS
Lonchura	*punctulata*	Nutmeg mannikin/scaly-breast munia, '91 OTA, GRIS; and disease USGS AI

Genus	Species	Common name and annotation
Lophura	*nycthemera*	Silver pheasant, GRIS
Lorius	*garrulus*	Chattering lory, GRIS
Melopsittacus	*undulatus*	Budgerigar, FL-FWC >10 yrs, est., GRIS; and disease USGS AI and WNV
Myiopsitta	*monachus*	Monk parakeet, '91 OTA; FL-FWC: >10 yrs, est.
Nandayus	*nenday*	Nenday parakeet, GRIS
Netta	*peposacea*	Rosybill ponchard duck; disease, USGS AI
Numida	*meleagris*	Helmeted guineafowl, GAE/Birdlife E1, GRIS; and disease, USGS AI
Nymphicus	*hollandicus*	Cockatiel, disease, USGS WNV
Oryzoborus	*angolensis*	Lesser seed-finch, GRIS
Padda	*oryzivora*	Java sparrow, Lacey Act; FL-FWC: >10 yrs, GRIS
Paroaria	*coronata*	Red-crested cardinal, GRIS
Pavo	*cristatus*	Peacock, GRIS; disease, USGS AI
Pavo	*muticus*	Green peafowl, GRIS
Phoenicopterus	*chilensis*	Chilean flamingo, GAE/Birdlife C, GRIS; and disease, USGS WNV
Pionites	*leucogaster*	White-bellied parrot, GRIS
Pionites	*melanocephala*	Black-headed parrot, GRIS
Poicephalus	*gulielmi*	Red-fronted parrot, GRIS
Poicephalus	*meyeri*	Meyer's parrot, GRIS
Poicephalus	*rufiventris*	Red-bellied parrot, GRIS
Poicephalus	*senegalus*	Senegal parrot, GRIS
Porphyrio	*porphyrio*	Purple swamphen, disease, USGS AI
Pseudeos	*fuscata*	Dusky lory, GRIS
Psittacula	*alexandri*	Red-breasted parakeet, GRIS
Psittacula	*eupatria*	Alexandrine parakeet, GAE/Birdlife E1, GRIS
Psittacula	*krameri*	Ring-necked parakeet, GAE/Birdlife C, GRIS; and disease, H9N2 AI virus see Mase et al. 2001. J. Virology 75:3490-3494
Psittacus	*erithacus*	Grey parrot, GRIS
Pycnonotus	*jocosus*	Red-whiskered bulbul, '91 OTA, Lacey Act, FL-FWC, GRIS
Sarcoramphus	*papa*	King vulture, disease, USGS WNV
Serinus	*mozambicus*	Yellow-fronted canary, GRIS
Sicalis	*flaveola*	Saffron finch, GRIS
Spheniscus	*demersus*	Blackfooted penguin, disease, USGS WNV
Spizaetus	*nipalensis*	Crested hawk-eagle, disease, USGS AI
Streptopelia	*decaocto*	Eurasian collared-dove, FL-FWC: <10 yrs, est., GRIS
Strix	*aluco*	Tawny owl, disease, USGS WNV
Strix	*uralensis*	Spotted wood-owl, disease, USGS AI
Struthio	*camelus*	Ostrich, GRIS

Genus	Species	Common name and annotation
Taeniopygia	*guttata*	Zebra finch, disease, USGS AI and WNV
Tiaris	*olivacea*	Yellow-faced grassquit, GRIS
Trichoglossus	*haematodus*	Rainbow lorikeet, GRIS
Turdus	*merula*	Blackbird, GRIS
Turdus	*philomelos*	Song thrush, GRIS
Uraeginthus	*bengalus*	Red-cheeked cordon-bleu, GRIS
Uraeginthus	*ianthinogaster*	Purple grenadier, GRIS
Vidua	*macroura*	Pintail whydah, GRIS
Zosterops	*japonicus*	Japanese white-eye, '91 OTA; and disease, USGS AI

TOTAL ANNOTATED NON-NATIVE BIRDS: 129 of 559 imported non-natives

NON-NATIVE FISH		
Acipenser	*ruthenus*	Sterlet, GRIS
Acipenser	*stellatus*	Starry sturgeon, GRIS
Arapaima	*gigas*	Arapaima, GRIS
Astronotus	*ocellatus*	Oscar, 1999 USGS report, FL invasives; Padilla & Wms, USGS NAS, GRIS
Betta	*splendens*	Siamese fighting fish, Padilla & Williams, GRIS
Brachydanio	*rerio*	Zebra danio, Padilla & Williams, USGS NAS
Callichthys	*callichthys*	Cascarudo, Padilla & Williams
Carassius	*auratus*	Goldfish, '91 OTA; Padilla & Williams, USGS NAS, GRIS
Carassius	*carassius*	Crucian carp, USGS NAS
Channa	*argus*	Northern snakehead, Lacey Act, USGS NAS
Channa	*asiatica*	Chinese snakehead, Lacey Act
Channa	*maculata*	Blotched snakehead, Lacey Act, USGS NAS
Chiloscyllium	*punctatum*	Brown-spotted catshark, GRIS
Cichla	*ocellaris*	Butterfly peacock, USGS NAS
Cyprinus	*carpio*	Common carp, 100 Worst, '91 OTA; Padilla & Wms, USGS NAS, GRIS
Danio	*rerio*	Zebrafish, GRIS
Huso	*huso*	Beluga, GRIS
Hypostomus	*plecostomus*	Suckermouth catfish, Armadilla del Rio; (H. spp.) Padilla & Wms, Army Corps ANSPR Bull. 04-1, USGS NAS
Lateolabrax	*japonicus*	Japanese seaperch, GRIS
Lates	*niloticus*	Nile perch, 100 Worst, GRIS
Micropterus	*salmoides*	Large-mouth bass, 100 Worst, GRIS
Misgurnus	*anguillicaudatus*	Oriental weatherfish, Padilla & Wms, USGS NAS, GRIS
Ophicephalus	*striatus*	Snakehead, Lacey Act
Oreochromis	*niloticus*	Nile tilapia, edrr.nbii.gov, Inv Sp. Database (O. spp.), USGS NAS, GRIS

Genus	Species	Common name and annotation
Osphronemus	*goramy*	Giant gourami, Padilla & Williams, GRIS
Osteoglossum	*bicirrhosum*	Arawana, Padilla & Williams
Panaque	*nigrolineatus*	Royal panaque, Padilla & Williams
Phractocephalus	*hemiliopterus*	Redtail catfish, Padilla & Williams
Poecilia	*petenensis*	Peteen molly, Padilla & Wms, USGS NAS
Poecilia	*reticulata*	Guppy, '91 OTA; Padilla & Wms, USGS NAS, GRIS
Pterophyllum	*scalare*	Freshwater angelfish, Padilla & Williams
Pygocentrus	*cariba*	Piranha (P. spp.) Padilla & Wms, 2+ State Lists
Pygocentrus	*piraya*	Piranha (P. spp.) Padilla & Williams, 2+ State Lists
Scleropages	*formosus*	Asian arowana, GRIS
Serrasalmus	*rhombius*	Red-eye pirhana, Padilla & Williams
Xiphophorus	*helleri*	Green swordtail, '91 OTA; Padilla & Wms, USGS NAS, GRIS

TOTAL ANNOTATED NON-NATIVE FISH: 36 of 121

NON-NATIVE MAMMALS		
Arctictis	*binturong*	Binturong (civet cat), disease, banned CDC 2004
Atelerix	*albiventris*	African pygmy hedgehog; disease - ringworm, etc. EID. + FMD,\\limited ban for FMD source countries, USDA 9 CFR 93.701
Atherurus	*africanus*	Brush-tailed porcupine, disease, banned CDC 2003
Axis	*axis*	Axis deer, '91 OTA
Callithrix	*jacchus*	Marmoset, disease – rabies, EID
Camelus	*dromedarius*	Dromedary camel, GRIS
Canis	*familiaris*	Dog, GRIS
Canis	*lupus x familiaris*	Wolf/dog hybrids, numerous state laws, see www.wolfdogalliance.org/legislation/statelaws.html
Capra	*falconeri*	Ibex, GRIS
Caracal	*caracal*	Guinea pig, GRIS
Cebus	*albifrons*	Yellow-breasted capuchin, GRIS
Cervus	*elaphus*	Red deer, 100 Worst, GRIS
Cervus	*nippon*	Sika deer, GRIS
Chinchilla	*lanigera*	Chinchilla, disease - ringworm, EID
Chlorocebus	*aethiops*	Vervet monkey, FL-FWC: >10 yrs, est.
Chrysocyon	*brachyurus*	African civet cat, disease, banned CDC 2004
Connochaetes	*gnou*	Black wildebeest, disease, malignant catarrhal fever; www.foodcontamination.ca/animalnet/2002/12-2002/animalnet_december_29.htm
Connochaetes	*taurinus*	Brindled wildebeest, same as black wildebeest; www.foodcontamination.ca/animalnet/2002/12-2002/animalnet_december_29.htm
Cricetomys	*gambianus*	Gambian pouch rat, FL-FWC: <10 yrs, est.; banned CDC 2003
Dactylopsila	*trivirgata*	Fallow deer, GRIS

Genus	Species	Common name and annotation
Dasyprocta	*punctata*	Central American agouti, GRIS
Felis	*nigripes*	Wildcat, GRIS
Genetta	*genetta*	Common genet (civet cat), disease, banned CDC 2004
Genetta	*tigrina*	Blotched genet (civet cat), disease, banned CDC 2004
Graphiuris	*murinus*	African dormice, disease, banned CDC 2003
Heliosciurus	*ounetatus*	African tree squirrel, disease, banned CDC 2003
Heliosciurus	*poensis*	African tree squirrel, disease, banned CDC 2003
Hemicentetes	*semispinosus*	Low-land streaked tenrec, disease, foot-and-mouth (FMD), \\limited ban for FMD source countries, USDA 9 CFR 93.701
Lama	*glama*	Llama, GRIS, and disease, USGS WNV
Lama	*pacos*	Alpaca, GRIS; and disease, USGS WNV
Lepus	*europaeus*	Brown hare, GRIS
Macaca	*fascicularis*	Long-tail macaque, 100 Worst, GRIS; and disease, B-virus, EID 98, USGS AI + Simian Foamy Virus, www.sciencedaily.com/releases/2005/07/050714004046.htm
Macaca	*mulatta*	Rhesus macaque, FL-FWC: >10 yrs, est., GRIS; and disease, B-virus, EID 1998
Macaca	*nemestrina*	Pigtail macaque, GRIS
Macaca	*sylvanus*	Barbary macaque, disease, USGS WNV
Macropus	*rufogriseus*	Bennett's wallaby, GRIS
Mastomys	*angolensis*	Angolan multimammate mouse, Lacey Act
Mastomys	*coucha*	Southern multimammate mouse, Lacey Act
Mastomys	*natalensis*	African soft-furred rat, Lacey Act
Mungos	*mungo*	Banded mongoose, Lacey Act
Mus	*musculus*	Mouse, 100 Worst, GRIS
Mustela	*putorius*	Ferret, GRIS; and disease, USGS AI
Nasua	*narica*	White-nosed coati, FL-FWC: >10 yrs, est.
Nyctereutes	*procyonoides*	Racoon dog, Lacey Act, GRIS
Oryctolagus	*cuniculus*	European rabbit, Lacey Act, 100 Worst, '91 OTA, GRIS
Ovis	*ammon*	Argali sheep, GRIS
Ovis	*aries*	Mouflon, GRIS
Panthera	*pardus*	Leopard, disease, USGS AI
Panthera	*tigris*	Tiger, disease, USGS AI
Paradoxurus	*hermaphroditus*	Civet cat, disease, banned CDC 2004
Pteropus	*poliocephalus*	Grey-headed flying fox, Lacey Act
Pteropus	*scapulatus*	Little red flying fox, Lacey Act
Pteropus	*vampyrus*	Malayan flying fox, Lacey Act
Rupicapra	*rupicapra*	Tatra chamois, GRIS
Saimiri	*sciureus*	Squirrel monkey, FL-FWC: >10 yrs, est.
Sciurus	*vulgaris*	Eurasian red squirrel, GRIS

Genus	Species	Common name and annotation
Suricata	*suricatta*	Meerkat, Lacey Act
Sus	*scrofa*	Feral pig, 100 Worst, '91 OTA; FL-FWC, GRIS
Tragelaphus	*strepsiceros*	Greater kudu, rabies, Rev. Infect. Dis. 1988:10 (Suppl. 4):S629-33
Trichosurus	*vulpecula*	Brushtail possum, Lacey Act, GRIS
Viverra	*civettina*	Malabar civet, disease, banned CDC 2004

TOTAL ANNOTATED NON-NATIVE MAMMALS: 61 of 263 non-native imports

NON-NATIVE REPTILES

Agama	*agama*	African redhead agama, FL-FWC: <10 yrs, est., GRIS
Ameiva	*ameiva*	Giant ameiva, FL-FWC: >10 yrs, est.
Anolis	*equestris*	Knight anole, FL-FWC: >10 yrs, est.
Anolis	*sagrei*	Brown anole, FL-FWC: >10 yrs, est., GRIS
Apalone	*spinifera*	Spiny softshell, NAS Impact
Basiliscus	*vittatus*	Brown basilisk, FL-FWC: >10 yrs, est.
Boa	*constrictor*	Common boa, HSUS, FL-FWC: >10 yrs, est., GRIS
Caiman	*crocodilus*	Spectacled caiman, FL-FWC: >10 yrs, est., USGS NAS, GRIS
Calotes	*versicolor*	Oriental garden lizard, FL-FWC: >10 yrs, est., GRIS
Chamaeleo	*calyptratus*	Veiled chameleon, FL-FWC: <10 yrs, est.
Chamaeleo	*jacksonii*	Jackson's 3 horned chameleon, HSUS
Chelus	*fimbriata*	Matamata, NAS Impact
Cnemidophorus	*lemniscatus*	Rainbow lizard, FL-FWC: >10 yrs, est.
Cnemidophorus	*montaguae*	Giant whiptail, FL-FWC: <10 yrs, est.
Ctenosaura	*similis*	Black spinytail iguana, FL-FWC: >10 yrs, est.
Cuora	*amboinensis*	South Asian box turtle, GRIS
Eunectes	*murinus*	Green anaconda, HSUS
Eunectes	*notaeus*	Yellow anaconda, HSUS
Furcifer	*pardalis*	Panther chameleon, GRIS
Gehyra	*mutilata*	Four-clawed gecko, GRIS
Gekko	*gecko*	Tokay gecko, FL-FWC: >10 yrs, est., GRIS
Geochelone	*pardalis*	Leopard tortoise, HSUS, livestock disease, USDA 2000 ban
Geochelone	*sulcata*	African spurred spot. tortoise, HSUS, livestock disease, USDA 2000 ban
Hemidactylus	*mabouia*	Tropical house gecko, FL-FWC: >10 yrs, est., GRIS
Hemidactylus	*turcicus*	Mediterranean gecko, FL-FWC: >10 yrs, est., GRIS
Iguana	*iguana*	Green iguana, HSUS, FL-FWC: >10 yrs, est., GRIS
Kachuga	*trivittata*	Burmese roofed turtle, HSUS, disease risk
Kinixys	*belliana*	Bell's h-backed tortoise, HSUS, livestock disease, USDA 2000 ban
Kinosternon	*scorpioides*	Scorpion mud turtle, NAS Impact

Genus	Species	Common name and annotation
Leiocephalus	*schreibersii*	Red-sided curlytail lizard, FL-FWC: >10 yrs, est.
Leiolepis	*belliana*	Butterfly lizard, FL-FWC: >10 yrs, est.
Lissemys	*punctata*	Indian flapshell turtle, GRIS
Mabuya	*multifasciata*	Many-lined grass skink, FL-FWC: >10 yrs, est.
Manouria	*emys*	Asian giant tortoise, GRIS
Natrix	*natrix*	Grass snake, HSUS, disease risk
Natrix	*tessellata*	Tesselated watersnake, NAS Impact
Pelodiscus	*sinensis*	Chinese softshell, USGS NAS, GRIS
Pelusios	*castaneus*	West African mud turtle, GRIS
Phelsuma	*cepediana*	Blue-tailed day gecko, GRIS
Phelsuma	*laticauda*	Gold dust day gecko, GRIS
Phelsuma	*lineate*	Lined day gecko, GRIS
Phelsuma	*madagascariensis*	Giant day gecko, FL-FWC: <10 yrs, est., GRIS
Platemys	*platycephala*	Grooved sideneck, NAS Impact
Ptyas	*korros*	Chinese ratsnake, HSUS, disease risk
Python	*molurus*	Burmese python, FL-FWC: <10 yrs, est., USGS NAS
Python	*reticulatus*	Reticulated python, HSUS
Siebenrockiella	*crassicollis*	Black marsh turtle, GRIS
Tarentola	*mauritanica*	Moorish gecko, GRIS
Trachemys	*stejnegeri*	Inagua slider, NAS Impact, GRIS
Varanus	*indicus*	Pacific monitor lizard, HSUS, disease risk
Varanus	*niloticus*	Nile monitor, FL-FWC: >10 yrs, est., USGS NAS
Varanus	*salvator*	Water monitor, NAS Impact

TOTAL ANNOTATED NON-NATIVE REPTILES: 52 of 710 non-native imports

NON-NATIVE INVERTEBRATES *All taxonomic groups are combined due to small number of annotations*		
Arachnids *Brachypelma*	*smithi*	Mexican redknee tarantula, GRIS
Brachypelma	*vagans*	Mexican red-rumped tarantula, U. FL, edis.ifas.ufl.edu/IN562
Crustaceans *Cherax*	*quadricarinatus*	Australian redclaw, USGS NAS, GRIS
Eriocheir	*sinensis*	Chinese mitten crab, 100 Worst, Lacey Act, USGS NAS, GRIS
Scylla	*serrata*	Mud crab, USGS NAS Fact Sheet
Insects *Papilio*	*demodocus*	Citrus butterfly, GRIS
Papilio	*memnon*	Great mormon, GRIS
Molluscs *Achatina*	*fulica*	African giant snail, 100 Worst, '91 OTA, GRIS
Perna	*viridis*	Asian green mussel, Aust. CSIRO NMPIS, USGS NAS, Sea Grant, GRIS

Pinctada	*margaritifera*	Black-lip pearl oyster, GRIS
Tapes	*philippinarum*	Manila clam, GRIS

TOTAL ANNOTATED NON-NATIVE INVERTEBRATES: 11 of 416 non-native imports

TOTAL ANNOTATED, ALL SPECIES: 302 of 2,241 IMPORTED NON-NATIVE SPECIES

Key to Common Abbreviations in Annotations

(Note: Web sites listed were last accessed between February and May 2007)

GRIS = annotation information for this species is available in the separate database, named DefendersFullData.xls (Appendix A, Item 6), which readers should refer to for risk information for the 191 species on this list that were identified as invasive or potentially invasive by the IUCN Invasive Species Specialist Group (ISSG), under a contract with Defenders to conduct a pilot project for the Global Register on Invasive Species (GRIS). See Appendix A, Item 7, the final GRIS report.

100 Worst = on IUCN Invasive Species Specialist Group list of World's 100 Worst Invasive Alien Species, available online at: www.issg.org.

'91 OTA = identified as in US in 1991 and net harmful by experts for 1993 "Harmful Non-Indigenous Species in the U.S." report, U.S. Congress Office of Technology Assessment online at www.wws.princeton.edu/ota/ns20/alpha_f.html; papers held by the authors at Defenders.

CDC 2003 = CDC interim rule, Restrictions on African Rodents, Prairie Dogs, [etc.] in Federal Register, 68:62353-69, 11/4/03.

CDC 2004 = CDC Order of Jan. 13, 2004 banning imports of all civet cat species, online at www.cdc.gov/ncidod/sars/civet_ban_exec_order.htm.

EID = Emerging Infectious Disease, 1/07, article, online at www.cdc.gov/ncidod/EID/13/1/06-0480.htm.

EID 1998 = S.R. Ostrowski et al. 1998. Emerging Infectious Disease 4:117-121.

FL-FWC = Florida Fish and Wildlife Conservation Commission's list of Exotic Wildlife, established ("est.") species only; online at http://myfwc.com/critters/exotics/exotics.asp.

GAE/Birdlife = Grupo de Aves Exóticas/Birdlife report "European list of birds: introduced alien species" 5/06, online at www.seo.org/media/docs/LISTA%20EXOT%20EUROPA%20may06.pdf for species in categories C or E1, only, indicating "Established" or "regular reproduction and risk of establishment," respectively.

HSUS = Franke, J., and T. Telecky. 2001. Reptiles As Pets. An Examination of the Trade in Live Reptiles in the United States. Report of the Humane Society of the U.S.

Lacey Act = regulated by U.S. Fish and Wildlife Service as "injurious" under the Lacey Act, 50 CFR 16.

Padilla & Williams = Padilla, D.K., and S.L. Williams. 2006. Beyond ballast water: aquarium and ornamental trades as sources of invasive species in aquatic ecosystems. Frontiers in Ecology and the Environment, Vol. 2, No. 3, pp. 131-138.

USDA 2000 = US Dept. of Agriculture rule banning importation etc. of certain land tortoises for livestock/ruminant disease risk, Federal Register, 65:15216-15218, 7/21/2000.

USGS AI = species listed as affected by H5N1, Avian influenza, by USGS Natl. Wildlife Health Ctr. online at www.nwhc.usgs.gov/disease_information/avian_influenza/affected_species_chart.jsp.

USGS NAS = listed as "exotic" and "established" under" Nonindigenous Aquatic Species database of USGS, http://nas.er.usgs.gov/queries/SpSearch.asp, under Advanced search in "Status" and "Exotic/transplant" fields; also abbreviation of "NAS" + "invasive", "harmful," "pest" or "impact" (where impact is negative) indicates the annotation resulted from the search of USGS NAS fact sheets for those terms.

USGS WNV = species listed as affected by West Nile Virus by USGS Natl. Wildlife Health Ctr., limited to species listed as with virus or viral RNA detected in tissue, online at www.nwhc.usgs.gov/disease_information/west_nile_virus/affected_species_chart.jsp.

APPENDIX C

DETAILS OF FEDERAL LAWS REGULATING IMPORTS OF MAJOR ANIMAL GROUPS

This appendix describes the current federal regulatory approach to live animal imports into the United States. It goes beyond the overview of the key statutes in Chapter 4 to address the many scattered regulations that can apply.

Section I lists regulations aimed at preventing invasive species or disease risks in the U.S. The information is organized by the main animal taxonomic groups and by the three main agencies that may regulate within each group—FWS, APHIS and CDC.

Section II discusses federal conservation statutes and regulations that address non-native animal species imports. Their goal generally is to reduce the exploitation of particular species in the countries from which those species are exported. These conservation statutes and regulations lie outside the scope of this report except to the extent that they may also incidentally reduce imports of these protected species, thus reducing invasiveness or disease risks to the United States that might be associated with them.

SECTION I - Regulations Aimed at Preventing Invasive Species or Disease Risks

Vertebrates

Amphibians

No amphibian is considered injurious under the FWS Lacey Act regulations.[1] No other FWS, CDC or USDA regulations exist specific to any invasiveness or disease risk amphibians may present.[2]

Birds

FWS - The FWS Lacey Act injurious species regulations prohibit imports of four potentially invasive birds: the pink starling (*Sturnus roseus*), dioch (*Quelea quelea*), Java sparrow (*Padda oryzivora*) and the red-whiskered bul-bul (*Pycnonotus jocusus*).[3]

APHIS - Regulations distinguish between commercial and pet birds.[4] Commercial birds are defined as those "imported for resale, breeding, public display, or any other purpose."[5] The importer must first obtain an import permit from the Veterinary Services (VS) office of APHIS.[6] A VS representative will inspect the quarantine facility that will house the birds.[7] VS can deny a permit on the basis of communicable disease conditions in the country of origin or absence of regulatory controls in that country that would prevent the spread of disease, or any other situation that presents a risk of spread of communicable disease.[8] In addition to the import permit, the importer also must have a certificate from a veterinary official of the exporting country stating the birds are free of communicable diseases and would not have been exposed to any diseases during the 90 days prior to export.[9] The birds will be quarantined for 30 days.[10] If the birds are found during quarantine to be infected with a communicable disease, APHIS will refuse their entry, or require them to be quarantined for an additional period of time or disposed of.[11]

Pets are defined as those "imported for the personal pleasure of their individual owners and are not intended for resale."[12] Pet birds are subject to less stringent measures than commercial birds, especially if entering from Canada or Mexico.[13]

CDC - To prevent the spread of avian flu, H5N1, the CDC issued an order on February 4, 2004, under the Public Health Service Act,[14] banning the imports of any birds from Cambodia, Indonesia, Japan, Laos, People's Republic of China including Hong Kong, South Korea, Thailand and Vietnam.[15] Since then, the CDC has amended the order several times, most recently on June 2, 2006.[16] As of mid-2007 the embargo also includes: Malaysia, Kazakhstan, Romania, Russia, Turkey, Ukraine, Nigeria, India, Egypt, Niger, Albania, Azerbaijan, Cameroon, Burma (Myanmar), Israel, Afghanistan, Jordan, Burkina Faso, Pakistan, Gaza, the West Bank, the Ivory Coast (Côte d'Ivoire), Sudan and Djibouti.[17] The order will stay in effect until further notice.

APHIS has a similar temporary ban on the importation of commercial birds from numerous countries and regions around the world where avian influenza has been found.[18]

Fish

FWS - The Lacey Act bans imports of two types of invasive fish: walking catfish of the Clariidae family, and snakeheads of the genera *Channa* or *Parachanna*.[19] (Several species of Asian carps also have been formally proposed for listing as injurious, but are not listed as of this writing.)[20] Also, elaborate fish health provisions adopted under the Lacey Act regulate imports of salmonids. All live salmonids must be accompanied by written approval from the director of the FWS and certified to be free of *Oncorhynchus masou*, the viruses causing viral hemorrhagic septicemia, infectious hematopoietic necrosis, and infectious pancreatic necrosis.[21]

APHIS - In 2006, APHIS promulgated regulations restricting the importation of fish in order to prevent the introduction and spread of the disease spring viremia of carp (SVC).[22] First reported in Europe and Asia, SVC is known to cause high morbidity and mortality in wild aquatic species.[23] Several outbreaks occurred in North Carolina, Missouri and Washington that were found to be associated with imports of fish from Asian countries where SVC had been reported.[24] The new regulations require that imports of SVC-susceptible species be accompanied by an import permit issued by APHIS[25] and a health

certificate issued by an official veterinarian in the country of export.[26]

The species affected by this regulation are: common carp, including koi carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), grass carp (*Ctenopharyngodon idellus*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), Crucian carp (*Carassius carassius*), tench (*Tinca tinca*) and sheatfish (*Silurus glanis*).

APHIS has also prohibited imports of particular baitfish, recreational and food fish species susceptible to viral hemorrhagic septicemia (VHS) from two Canadian provinces. Salmonid species from the affected Canadian provinces may be imported if accompanied by a health certificate.[27]

Mammals

FWS - The Lacey Act regulations prohibit imports of live fruit bats (genus *Pteropus*); mongoose or meerkat (genera *Atilax*, *Cynictis*, *Helogale*, *Herpestes*, *Ichneumia*, *Mungos*, and *Suricata*); European rabbit (genus *Oryctolagus*); Indian wild dog, red dog, or dhole (genus *Cuon*); rat or mouse of the genus *Mastomys*; raccoon dog (*Nyctereutes procyonoides*); and the brushtail possum (*Trichosurus vulpecula*).[28]

CDC - Under the PHSA, CDC regulates imports of several mammal species connected to zoonotic diseases. SARS was first reported in Asia in 2003 and quickly spread internationally.[29] In January 2004, six months after the SARS outbreak had been contained,[30] CDC prohibited the import of live or dead civet cats (of the Viverridae family) a SARS vector.[31]

In May 2003, another zoonotic virus appeared—monkeypox. In June 2003, CDC issued an order prohibiting the importation of all rodents from Africa.[32] That order was later adopted as a regulation; it allows limited imports of products derived from African rodents if processed so as to prevent transmission of monkeypox and live African rodents with written permission from CDC.[33]

The CDC regulates imports of bats under a broader regulation governing etiological agents, hosts, and vectors.[34] Live bats imported into the U.S. must be accompanied by a CDC permit.[35] Importers must quarantine all imported bats for six months after entry.[36] The primary concern is rabies, but the bats are tested for any disease during quarantine.[37]

The CDC also requires dogs and cats arriving at U.S. ports to be inspected and only admitted if they show no signs of communicable diseases.[38] In addition, all dogs must have a rabies vaccination certificate to enter unless certain exceptions apply.[39]

The CDC prohibits imports of all non-human primates for use as pets.[40] (However, many states allow primates that are in the country to be owned as pets.) Anyone importing primates for "bona fide scientific, educational, or exhibition purposes" must be registered with CDC.[41] The importer must keep records and notify CDC within 24 hours if any member of their staff is suspected of contracting a communicable disease from the primates or if any primate falls ill with symptoms of yellow fever, monkeypox, or Marburg/Ebola disease.[42]

APHIS - Coverage by APHIS of mammal imports comes from the Animal Health Protection Act (AHPA).[43] It aims at diseases and pests of "livestock," limited to "farm-raised animals,"[44] such as cattle, horses, sheep and swine. Given their narrow focus, generally on domesticated species, and their very complex permutations, these import regulations designed to prevent the introduction and spread of mad cow disease, foot-and-mouth disease, brucellosis, and other diseases will not be summarized here.[45]

USDA's limitations under the AHPA are illustrated by an advisory posted on the VS Web site:

"APHIS does not have animal health requirements for the importation of fish, reptiles, lions, tigers, bears, mink, rabbits, sugar gliders, foxes, monkeys, endangered species, guinea pigs, hamsters, gerbils, mice, rats, chinchillas, squirrels, mongoose, chipmunks, ferrets, or other rodents provided they have not been inoculated with any pathogens for scientific purposes."[46]

This advisory is incomplete and non-exhaustive, as APHIS lacks "animal health requirements" for numerous other taxa as well. (Amphibians, armadillos and crustaceans are just a few examples.)

APHIS also regulates the importation of brushtail possums (*Trichosurus vulpecula*), hedgehogs (of the Erinaceidae family) and tenrecs (of the Tenrecidae family).[47] Hedgehogs and brushtail possums from New Zealand are prohibited to protect livestock from tuberculosis.[48] It is prohibited to import hedgehogs and tenrecs from any region where foot-and-mouth disease exists.[49] Imports of hedgehogs and tenrecs from all other regions must be accompanied by an APHIS import permit[50] and a health certificate issued by an official veterinarian in the country of export verifying the animals are free from ectoparasites such as ticks, mites, and lice.[51] Elephants, hippopotami, rhinoceroses or tapirs cannot be imported without an import permit and a health certificate verifying the animals are free from ectoparasites that could carry disease communicable to livestock.[52]

Reptiles

FWS - The only invasive reptile banned by the FWS under the Lacey Act is the brown tree snake (*Boiga irregularis*).[53]

APHIS - In 2000, USDA issued a rule banning imports of three land tortoises because they are vectors of heartwater, an acute infectious disease with a high rate of mortality in domestic ruminant livestock, wild and farmed white-tailed deer, and wild pronghorns.[54]

CDC - The CDC regulates imports of turtles to prevent the spread of *Salmonella* and *Arizona* bacteria.[55] All turtles, except marine species, with a carapace shorter than four inches are prohibited in trade without a permit or unless the shipment is for non-commercial purposes and contains fewer than seven turtles.[56] After the turtles enter the U.S. they are subject to regulations enforced by the DHHS Food and Drug Administration that prohibit their sale.[57]

Invertebrates

FWS - The Lacey Act regulations prohibit import of two invasive aquatic invertebrates: mitten crabs (genus *Eriocheir*) and zebra mussels (*Dreissena polymorpha*).

APHIS - The Plant Protection Act (PPA)[58] regulates imports of "plant pests," defined as "any living stage of any insects, mites, nematodes, slugs, snails, protozoa, or other invertebrate animals…which can directly or indirectly injure or cause disease or damage in any plants."[59] Imports of any live plant pest require a permit issued by APHIS's Plant Protection and Quarantine (PPQ) division.[60]

Permit applications for imports of any live insects that may be plant pests are reviewed by PPQ, which forwards the applications to the relevant state officials for comments.[61] PPQ considers the state comments in deciding whether to grant the permits and, if so, with what conditions.[62] Lists of potential plant pests, including whole families and orders of insects, mites, and other animals for which APHIS will take action to block them if found at borders, are available on its Web site.[63]

Live adult honeybees may be imported only from Australia, Canada and New Zealand.[64] Bumblebees (*Bombus impatiens* and *Bombus occidentalis*), alfalfa leafcutter bees (*Megachile rotundata*), blue orchard bees (*Osmia lignaria*) and horn-faced bees (*Osmia cornifrons*) may be imported from Canada only.[65] Live bees, except honeybees, of the genus *Apis* are banned from import unless originating in Canada.[66] Importing any other bee species from any non-approved countries requires a PPQ permit.[67]

APHIS Biotechnology Regulatory Services has specialized regulations under the PPA that would apply to the import of genetically engineered animals, to the extent they are potential plant pests. These regulations are specific to engineered arthropods.[68] While several have been developed and test-released in controlled situations in the U.S., none have been proposed to be imported to date.

CDC - Insects that pose a risk to human health are subject to CDC regulations governing the importation of etiological agents, hosts, and vectors[69] and require a permit.[70]

SECTION II - Conservation Statutes and Regulations that Address Imports of Protected Non-native Animals

The Endangered Species Act (ESA)[71] lists 1,175 animal species as threatened or endangered.[72] Roughly half of these are foreign species.[73] The ESA prohibits imports of any listed endangered or threatened species unless accompanied by a permit.[74] The ESA also implements the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES).[75] Species listed on CITES Appendix I, those most gravely in danger of extinction due to trade, can be imported only with a valid export and import permit,[76] and if not to be used for primarily commercial purposes.[77] The export permit is only issued after the exporting country has determined that the animal was not taken in violation of the law and the export will not be "detrimental to the survival of that species."[78] The import permit will be granted if it is found that the facility to receive the animal will be able to care for it adequately.[79] There are currently 529 animal species included on Appendix I of CITES.[80]

Under the ESA, the FWS can promulgate special rules for species listed as threatened that provide exceptions for activities that would otherwise be prohibited under the act.[81] For example, the FWS administers special rules with regards to 13 species of primates.[82] The rule exempts those species from the prohibitions of the ESA, including importation, if the individuals were born in captivity.[83] The exemption does not apply to chimpanzees (*Pan troglodytes*) within or originating from its historic range, whether in the wild or captivity, other than offspring of chimpanzees already imported into the United States.[84]

The FWS also administers several laws designed to protect foreign birds from over-exploitation in their native ranges. The Wild Bird Conservation Act (WBCA)[85] establishes a moratorium on imports of all foreign wild birds included on any appendix of CITES unless the Secretary of Interior makes a finding that trade does not pose a threat to the species.[86] The secretary also has the authority to establish a moratorium or quotas for bird species not listed on CITES but in need of protection.[87] Exemptions are made for captive-bred species and those for which a sustainable management plan exists.[88] Import permits are available for scientific research, zoological breeding programs, cooperative breeding programs and returning pets.[89] Currently, the budgie (*Melopsittacus undulates*), cockatiel (*Nymphicus hollandicus*) and many game bird species are not subject to the WBCA moratorium.[90]

The Migratory Bird Treaty Act (MBTA) implements bird conservation treaties the U.S. signed with Great Britain, Mexico, Japan and the Soviet Union.[91] The MBTA prohibits imports of any birds listed under the treaties unless permitted by regulation.[92] FWS regulations specify the number of migratory game birds—doves, pigeons, and waterfowl—that can be imported by country.[93] Any imports of live migratory birds require a permit.[94] Considerable overlap exists among the birds listed in the migratory species treaties and those listed under the ESA and CITES, requiring additional permits.[95]

Under the Marine Mammal Protection Act, the National Marine Fisheries Service in the Department of Commerce administers a ban on imports of any live marine mammals except for scientific research, public display, photography for "educational or commercial purposes, or enhancing the survival of the species."[96]

1. 50 C.F.R. § 16.14 (2005).

2. 50 C.F.R. § 16.12(a) (2005).

3. Regulations promulgated under the authority of, *inter alia*, Agriculture Marketing Act of 1946, 7 U.S.C. § 1622; Animal Health Protection Act, 7 U.S.C. §§ 8301–8317; Federal Food, Drug, and Cosmetic Act, 21 U.S.C. §§ 136, 136a (2000).

4. 9 C.F.R. § 93.100 (2007).

5. 9 C.F.R. § 93.103(a)(1) (2007).

6. 9 C.F.R. § 93.103(a)(2)(i) (2007).

7. 9 C.F.R. § 103(a)(2)(ii) (2007).

8. 9 C.F.R. § 93.104(a),(b) (2007).

9. 9 C.F.R. § 93.106(a) (2007).

10. 9 C.F.R. § 93.106(a) (2007).

11. 9 C.F.R. § 93.100 (2007).

12. For restrictions on the import of pet birds see: 9 C.F.R. §§ 93.101(c), 93.102(d), 93.203(b).

13. Public Health Service Act, 42 U.S.C. §§ 201 et seq. (2000).

14. Order of the Centers for Disease Control and Prevention, Department of Health and Human Services (Feb. 4, 2004), *available at* www.cdc.gov/flu/avian/pdf/embargo.pdf.

15. Amendments to the original CDC order are available at http://www.cdc.gov/flu/avian/outbreaks/embargo.htm.

16. Order of the Centers for Disease Control and Prevention, Department of Health and Human Services (June 2, 2006) *available at* http://www.cdc.gov/flu/avian/pdf/embargo-djibouti-060206.pdf; *see also* Amendment of February 4, 2004, Order to Embargo Birds and Bird Products Imported From Djibouti, 71 Fed. Reg. 35,434 (June 20, 2006). The embargo was lifted for Hong Kong in March 2004 because of measures taken by government officials there to stop the spread of the disease. *See* Order of the Centers for Disease Control and Prevention, Department of Health and Human Services (Mar. 10, 2005) *available at* www.cdc.gov/flu/avian/pdf/hongkong.pdf.

17. Highly Pathogenic Avian Influenza; Additional Restrictions, 69 Fed. Reg. 25,820 (May 10, 2004) (to be codified at 9 C.F.R. pts. 93, 94, 95); Afghanistan, Albania, Azerbaijan, Burkina Faso, Cambodia, Cameroon, Denmark (Funen County only), Djibouti, Egypt, France (VS defined restricted zone only), Germany (Kreis of Muldental, Kreis of Torgue-Oschatz, and Kreis of Döbeln only), Hungary (Bacs-Kiskun and Csongrad counties only), India, Indonesia, Israel, Ivory Coast (Côte d'Ivoire), Japan, Jordan, Laos, Kazakhstan, Malaysia, Myanmar, Niger, Nigeria, Pakistan, Palestinian Autonomous Territories, Peoples' Republic of China, Romania, Russia, South Korea, Sudan, Sweden (Kalmar county only), Thailand, Turkey, Ukraine, United Kingdom (counties of Norfolk and Suffolk, England), and Vietnam. *See also* Animal and Animal Product Import, Animal and Plant Health Inspection Service, United States Department of Agriculture *at* www.aphis.usda.gov/import_export/animals/live_poultry.shtml (last visited Mar. 11, 2007).

18. 50 C.F.R. § 16.13 (2005).

19. Proposed Rule Injurious Wildlife Species; Silver Carp (*Hypophthalmichthys molitrix*) and Largescale Silver Carp (*Hypophthalmichthys harmandi*), 71 Fed. Reg. 52,305 (Sept. 5, 2006).

20. 50 C.F.R. § 16.13(a)(3) (2005).

21. Spring Viremia of Carp; Import Restrictions on Certain Live Fish, Fertilized Eggs, and Gametes, 71 Fed. Reg. 51,429 (Aug. 30, 2006) (to be codified at 9 C.F.R. pt. 93).

22. *Id.*

23. *Id.*

24. 9 C.F.R. § 93.903 (2007).

25. 9 C.F.R. § 93.904 (2007).

26. Imports must comply with the requirements in 50 C.F.R. § 16.13(a)(3), (b) (2005).

27. 50 C.F.R. § 16.11(a) (2005).

28. For a timeline of the outbreak, see the World Health Organization, Update 92-SARS: Chronology of a Serial Killer, *at* http://www.who.int/csr/don/2003_07_04/en/index.html (last visited Mar. 11, 2007).

29. The World Health Organization, The SARS Outbreak Contained Worldwide, *at* www.who.int/mediacentre/news/releases/2003/pr56/en/ (last visited Mar. 11, 2007).

30. Order of the Centers for Disease Control and Prevention, Department of Health and Human Services (Jan. 13, 2004) *available at* www.cdc.gov/ncidod/sars/civet_ban_exec_order.htm. However, evidence that has recently come to light indicates that bats might have also contributed to the SARS outbreak. *See* Susanna K. P. Lau et al., *Severe Acute Respiratory Syndrome Coronavirus-Like Virus in Chinese Horseshow Bats* 102 Proc. of the Nat'l Acad. of Sci. 14040 (2005).

31. Control of Communicable Diseases; Restrictions on African Rodents, Prairie Dogs, and Certain Other Animals, 68 Fed. Reg. 62,369 (Nov. 4, 2003).

32. 42 C.F.R. § 71.56 (2006).

33. 42 C.F.R. § 71.54 (2006).

34. The permit, document number 101005, can be found on the CDC website at, www.cdc.gov/od/ohs/biosfty/imprtper.htm.

35. *See* http://www.cdc.gov/od/eaipp/forms/Permit_to_Import_or_Transport_Live_Bats_Fillable_Form.pdf.

36. *Id.*

37. 42 C.F.R. § 71.51(b)(1) (2006).

38. 42 C.F.R. § 71.51(c) (2006).

39. 42 C.F.R. § 71.53(c) (2006).

40. 42 C.F.R. § 71.53(b),(c) (2006).

41. 42 C.F.R. § 71.53(e)(2),(3) (2006).

42. Animal Health Protection Act, 7 U.S.C. §§ 8301-8321 (2000).

43. 7 U.S.C. § 8302(10) (2000).

44. See Veterinary Services Import/Export website for more details at www.aphis.usda.gov/vs/ncie/ (last visited Mar. 11, 2007).

45. *See* Veterinary Services, Importation of Pets and Other Animals into the United States, *at* www.aphis.usda.gov/vs/ncie/pet-info.html (last visited Mar. 11, 2007).

46. 9 C.F.R. §§ 93.700-93.707 (2007).

47. 9 C.F.R. § 93.701(b) (2007); Importation of Brushtail Possums and Hedgehogs From New Zealand, 60 Fed. Reg. 4372 (Jan. 23, 1995) (to be codified at 9 C.F.R. pt. 92).

48. 9 C.F.R. § 93.701(a) (2007).

49. 9 C.F.R. § 93.704 (2007).

50. 9 C.F.R. § 93.705 (2007).

51. 9 C.F.R. §§ 93.800-93.807 (2007).

52. 50 C.F.R. § 16.15(a) (2005).

53. 9 C.F.R. § 93.701 (2007) (banning the import of leopard tortoise (*Geochelone pardalis*), African spurred tortoise (*Geochelone sulcata*), and Bell's hingeback tortoise (*Kinixys belliana*).

54. 42 C.F.R. § 71.52 (2006).

55. 42 C.F.R. § 71.52(b)-(d) (2006).

56. 21 C.F.R. § 1240.62(b) (2006).

57. Plant Protection Act, 7 U.S.C. §§ 7701-7772 (2000).

58. 7 C.F.R. § 330.100 (2007).

59. 7 C.F.R. § 330.200 (2007). PPQ Form 526 is available http://www.aphis.usda.gov/ppq/forms/ppqform526.pdf. In addition, special PPQ regulations govern imports of particular species. Three snails are prohibited: the giant African snail (Achatina fulica), channeled or golden apple snail (*Pomacea canaliculata*), and decollate snail (*Rumina decollata*). *See* Plant Protection and Quarantine Plant Pest Permits, *at* http://www.aphis.usda.gov/ppq/permits/plantpest/faqs-import-snails_slugs.html (last visited Mar. 11, 2007). Though prohibited to prevent damage to crops, the giant African snail, among other snails, also presents a human health risk. Some snails are infected with a dangerous parasite, *Angiostrongylus cantonensis*, which can be passed to humans by eating raw or undercooked snails. *See Angiostrongylus cantonensis* Infection, *at* www.cdc.gov/ncidod/dpd/parasites/angiostrongylus/factsht_angiostrongylus.htm (last visited Mar. 11, 2007). Special regulations apply to snails approved for import for human consumption. *See* Plant Protection and Quarantine Plant Pest Permits, *at* http://www.aphis.usda.gov/ppq/permits/plantpest/faqs-import-snails_slugs.html (last visited Mar. 11, 2007).

60. *See* Overview of Plant Pest and Noxious Weeds Permitting Process, *at* www.aphis.usda.gov/ppq/permits/overview.html (last visited Mar. 11, 2007).

61. *Id.*

62. *See* United States Department of Agriculture Animal and Plant Health Inspection Service Regulated Pest List, *at* www.aphis.usda.gov/ppq/regpestlist/ (last visited Mar. 11, 2007). It includes approximately 100 insect species, 10 mites and 2 nematodes.

63. 7 C.F.R. § 322.4(a) (2007).

64. 7 C.F.R. §§ 322.4(c), 322.5(d) (2007).

65. 7 C.F.R. § 319.76-2(a) (2007).

66. 7 C.F.R. § 322.14 (2007).

67. 7 C.F.R. pt. 340 (2007). APHIS recently opened an International Activities webpage, see www.aphis.usda.gov/brs/arthropod_index.html.

68. 42 C.F.R. § 71.54 (2006).

69. *See*: www.cdc.gov/od/eaipp/forms/Permit_to_Import_or_Transport_Etiologic_Agents_Hosts_or_Vectors_of_Human_Disease.pdf (last visited Mar. 11, 2007).

70. Endangered Species Act, 50 U.S.C. §§ 1531-1544 (2000).

71. 50 C.F.R. § 17.11 (2006); *see also* USFWS Threatened and Endangered Species System (TESS), *at* http://ecos.fws.gov/tess_public/SpeciesReport.do?dsource=animals (last visited Mar. 11, 2007).

72. USFWS Threatened and Endangered Species System (TESS), Foreign Listed Species, *at* http://ecos.fws.gov/tess_public/SpeciesReport.do?lead=10&listingType=L (last visited Mar. 11, 2007).

73. 50 U.S.C. § 1539(1)(A).

74. Convention on International Trade in Endangered Species, Mar. 3, 1973, 993 U.N.T.S. 243.

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76. CITES, *supra*, at art. III(3)(c).

77. CITES, *supra* note 75, at art. III(2).

78. CITES, *supra* note 75, at art. III(3).

79. The CITES Species, *at* http://www.cites.org/eng/disc/species.shtml (last visited Mar. 11, 2007).

80. 16 U.S.C. § 1533(d) (2000).

81. *50 C.F.R. § 17.40(c)(1) (2006) (The species are lesser slow loris, Nycticebus pygmaeus; Philippine tarsier, Tarsius syrichta; white-footed tamarin, Saguinus leucopus; black howler monkey, Alouatta pigra; stump-tailed macaque, Macaca arctoides; gelada baboon, Theropithecus gelada; Formosan rock macaque, Macaca cyclopis; Japanese macaque, Macaca fuscata; Toque macaque, Macaca sinica; long-tailed langur, Presbytis potenziani; purplefaced langur, Presbytis senex; Tonkin snub-nosed langur, Pygathrix (Rhinopithecus) avunculus; and, in captivity only, chimpanzee, Pan troglodytes).*

82. 50 C.F.R. § 17.40(c)(2) (2006).

83. 50 C.F.R. § 17.40(c)(3) (2006).

84. Wild Exotic Bird Conservation Act, 16 U.S.C. §§ 4901-4916 (2000).

85. 16 U.S.C. § 4904 (2000).

86. 16 U.S.C. § 4907 (2000).

87. 16 U.S.C. § 4905 (2000).

88. 16 U.S.C. § 4911 (2000).

89. Game bird species not subject to the moratorium are the following families: Anatidae, Cracidae, Dromaiinae, Gruidae, Megapodidae, Numididae, Phasianidae, Rheidae, and Struthionidae. 16 U.S.C. § 4903(2)(B)(ii) (2000).

90. Migratory Bird Treaty Act, 16 U.S.C. §§ 703-712 (2000).

91. 16 U.S.C. § 703 (2000).

92. 50 C.F.R. § 20.61 (2006).

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94. To compare lists of migratory bird species protected under various Federal statutes, see www.fws.gov/migratorybirds/intrnltr/mbta/compare.pdf (last visited Mar. 11, 2007).

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ENDNOTES

Introduction and Summary

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Chapter 1

3. Fish and Wildlife Service (FWS), Office of Law Enforcement Intelligence Unit. *U.S. Wildlife Trade: An Overview for 1997-2003*, online at www.fws.gov/le/pdffiles/Wildlife%20Trade%20Overview%20Report.pdf .

4. Material in this paragraph is adapted from the presentation of Roland Marquis, Senior Wildlife Inspector, FWS Office of Law Enforcement, in: Roth, D. 2004. Proceedings of Aug. 4, 2004, meeting, Wildlife Survival and National Security – Enhancing Collaboration to Combat Threats to Wildlife and Related Threats to National Security. System Planning Corporation, Arlington, VA.

5. For more information on ports of entry for wild animal shipments, see www.fws.gov/le/ImpExp/Designated_Ports.htm, www.fws.gov/le/ImpExp/Canadian_Border_Ports.htm, www.fws.gov/le/ImpExp/Mexican_Border_Ports.htm, and www.fws.gov/le/ImpExp/Special_Ports.htm.

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7. *Id.*.

8. For complete alphabetized lists of scientific names of the wild animal species in the native and non-native categories, see the links at Defenders' special companion webpage for this report, www.defenders.org/animalimports, which are summarized in Appendix A.

9. For the FWS regulation and further discussion of this issue, see recommendation 4 in Chapter 6 on the issue of full species identifications.

10. A very small proportion of live wild animal imports were recorded volumetrically, e.g., cubic meters or square feet; they are excluded from this report.

11. The coarse screening process does not take into account the quantity of each individual species imported from 2000-2004, which ranged from a few individuals of a species to many hundreds of thousands. As the goals of this report are prospective rather than retrospective, the issue of past quantities appears tangential to the issue of whether screening at the species level for future proposed imports would be feasible and useful in a precautionary program. Further, the import quantity of a particular species does not necessarily directly correlate to its risk of release or escape from captivity, or of spreading an infectious disease.

Chapter 2

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23. OTA. 1993. *supra*, endnote 13, at p. 70.

24. *Id.*, at p. 71.

25. The OTA 1993 report process included several contracted background studies by experts in various animal taxa, whose summary findings, based on compiled information through 1991, were presented in the main report. See Appendix B, and explanation of the "'91 OTA" annotation in its Key to common abbreviations to annotations.

26. Much of the information from these case studies is adapted from the IUCN ISSG's Global Invasive Species Database, online at www.issg.org/database/welcome/.

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28. See entry for lionfish in U.S. Geological Survey Nonindigenous Aquatic Species database, online at: http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=963 .

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38. See Wikipedia entry for "species"; online at: http://en.wikipedia.org/wiki/Species_concept#Numbers_of_species .

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Chapter 3

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Chapter 4

80. A few other agencies also may address specific wild animal imports within their specialty areas, but they are far less important than the FWS, APHIS, and CDC.

81. 18 U.S.C. 42(a)(1). Additionally, the Lacey Act Amendments of 1981 prohibit imports of fish and wildlife that were taken from the wild in violation of any U.S. law or treaty or any foreign law. 16 U.S.C. 3372(a)(1),(2)(A), and the Captive Wildlife Safety Act of 2003 amended the Lacey Act Amendments of 1981 to prohibit imports of live lions, tigers, leopards, cheetahs, jaguars, and cougars, except via a special permit. Public Law No: 108-19.

82. 50 *Code of Federal Regulations*. 16.11 et seq.

83. 50 *Code of Federal Regulations*. 16.22

84. FWS's authority for this is in the Endangered Species Act, at 16 USC 1538(e).

85. 50 *Code of Federal Regulations* 14.91(a)

86. 50 *Code of Federal Regulations*. 14.91(c)

87. 50 *Code of Federal Regulations*. 14.61; see www.le.fws.gov/faqs.htm

88. 50 *Code of Federal Regulations*. 14.52(a)

89. 50 *Code of Federal Regulations*. 14.53

90. 7 *U.S.Code*. 8303(a)(1). Under sec. 8303(13): "the term 'pest' means any [organism] that can directly or indirectly injure, cause damage to, or cause disease in livestock." Under sec. 8303(10): "the term 'livestock' means all farm-raised animals."

91. 7 *U.S.Code*. 7701-7772.

92. A special provision at 7 U.S.C. 7712(g) governs imports of animals that are "biological control organisms," providing: "In the case of biological control organisms, the Secretary may publish, by regulation, a list of organisms whose movement in interstate commerce is not prohibited or restricted. Any listing may take into account distinctions between organisms such as indigenous, nonindigenous, newly introduced, or commercially raised."

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Chapter 5

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