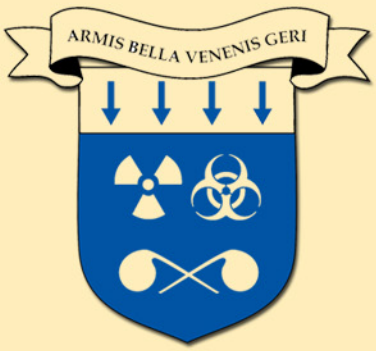
Agroterrorism and Foot-And-Mouth Disease: Is the United States Prepared?

Major Michael E. Peterson, USAF



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by

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Maxwell Air Force Base, Alabama 36112-6427

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The Author

Major Mike Peterson is a U.S. Air Force Aviator assigned to Headquarters Air Combat Command, Battle Management Operations Division, Langley AFB, VA. He graduated from the United States Air Force Academy in 1987 with a Bachelor of Science degree, and the Ohio State University in 1995 with a Master of Arts degree in Military History. He earned his navigator wings in 1988 and has had flying assignments in both U.S. and NATO E-3 AWACS squadrons. Major Peterson also served a tour at the U.S. Air Force Academy as an Assistant Professor and Course Director in the Military Arts and Sciences Department. He is a 2001 graduate of the Air Command and Staff College, Maxwell AFB, AL.

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Abstract

Since the mass casualty terrorist attacks of Al Qaeda against the World Trade Center towers and the Pentagon, subsequent anthrax attacks, and with the gradual proliferation of weapons of mass destruction (WMD), the U.S. Government has been galvanized into action to provide greater homeland security against a terrorist WMD attack on a major U.S. city or other assets. Until just recently, however, the government ignored the threat of a possible terrorist attack on another key sector of the U.S economy, U.S. farms and feedlots. "Agroterrorism," a concept foreign to the average citizen, is a serious threat that could cripple the agricultural industry, destroy consumer confidence, and cause billions of dollars of damage to the U.S. and world economy. While the U.S. has begun to acknowledge this growing agroterrorist threat, there is a great amount of defensive work to be done. In particular, there is one major threat that needs immediate attention, before it is too late – the defense against a possible foot-and-mouth disease (FMD) attack.

Foot-and-mouth disease, one of the most contagious viruses known, might be the perfect weapon for an agroterrorism attack. To understand this problem, it is important to first examine the FMD virus in detail and to discuss the types of terrorists or states that might be interested in using foot-and-mouth disease against U.S. livestock. Also, in order to develop an effective response, we should understand the characteristics that make FMD an extremely important threat and why the U.S. is especially vulnerable. Finally, it is useful, indeed essential, to explore the response mechanisms in place today to handle a FMD outbreak and to make recommendations for future improvements. Such an analysis will make clear the need for immediate increased funding, and heightened awareness and participation at the federal, state, and local levels. Such measures are imperative if the United States plans to avoid a disaster similar to the one that devastated the United Kingdom countryside in 2001.

Agroterrorism and Foot-and-Mouth Disease:

Is the United States Prepared?

Michael E. Peterson

Introduction

Since the September 11, 2001, terrorist attacks on the twin towers of the World Trade Center in New York City and the Pentagon building, the United States has gone on full alert to the possibilities of mass casualty terrorist threats. Already, the economic costs of those attacks have exceeded $100 billion if one factors in the expenses of cleaning up the sites, replacing the structures, compensating the families, and rebuilding the businesses lost. The attack also had negative impacts on the stock market, consumer confidence, and had devastating effects on the airline and related travel industries.

Moreover, the costs of the war on terrorism at home and abroad could run into the hundreds of billions over time. The United States has prosecuted a war in Afghanistan against the Taliban/Al Qaeda and other terrorist operatives and has begun a major new homeland security effort.

The anthrax attacks that followed the September 11, 2001, attacks confirmed the previous warnings of some experts that, in the cases of biowarfare or bioterrorism, it was not going to be a question of if, but, rather of when such attacks would take place. *When* has already occurred and the U.S. Executive Branch, Congress, the media, and the public are now much more alert to the danger of biological agents being used in the continental United States as well as elsewhere in the world.

The United States and other nations lost approximately 3,000 lives within an hour at the World Trade Center and the Pentagon. Additional victims were claimed by the subsequent anthrax attacks and war in

Afghanistan. This has led to a heightened sense of risk since over-run laboratories maintained by Al Qaeda and Taliban operatives indicated their interest and work toward acquiring nuclear, radiological, biological, and chemical weapons for future use.

This heightened sense of risk has made U.S. homeland defense officials more sensitive to other key targets that might be attacked in the continental United States. One such target might be the cattle and pig herds and other meat industries that could be subject to attack by highly contagious biological agents such as foot-and-mouth disease (FMD). This disease devastated the herds of the United Kingdom in the 2001 naturally occurring epidemic. The fear now is that the next chapters in our war with terrorism may see agroterrorist attacks using foot-and-mouth disease as a weapon.

Across the English countryside in 2000, workers faced the grim task of dousing thousands of pig and cattle carcasses in oil and placing them on pyres of coal, straw, and rail ties for incineration. Markets were running out of domestic beef and tens of thousands of livestock-related jobs were lost. In an attempt to lessen the spread of the disease and keep the movement of people and animals to a minimum, government officials closed national parks and canceled horseracing, rugby, and soccer matches. In Ireland, government leaders cancelled Dublin's St. Patrick's Day celebration while Scotland disinfected all vehicles entering from Britain. In 2000, across the English Channel, Belgian farmers clashed with police outside the European Union headquarters amid growing fears that foot-and-mouth disease would spread to continental Europe. Teams wearing protective clothing disinfected British aircraft arriving in Germany, and agricultural workers in Spain, France, Holland, Belgium, and Germany began the preventative slaughter of over 55,000 animals. For the first time since 1967, foot-and-mouth disease re-emerged in the UK and was a threat to spread throughout Europe.[1]

All indications up to this point reveal that this February 19, 2001, outbreak of foot-and-mouth disease at a small pig farm in Northumberland, Great Britain, was caused by a natural introduction of the virus.[2] But, what if a terrorist had caused this biological disaster, and, furthermore, what if this catastrophe were to take place on U.S. soil? Throughout the past decade and particularly after September 11, 2001, the U.S. Government has become much more concerned with the proliferation of weapons of mass destruction (WMD) and how the U.S. might respond to a terrorist WMD attack on a major city. Until the September 11, 2001,

and subsequent anthrax attacks, however, the U.S. Government had virtually ignored the threat of a possible terrorist attack on U.S. farms and feedlots. "Agroterrorism," a threat unknown to the average man, is an economic disaster still waiting to happen. According to Dr. Corrie Brown from the College of Veterinary Medicine at the University of Georgia, "A terrorist wishing to cause severe reverberating financial consequences could simply introduce a foreign disease into American livestock, which would set off a chain reaction touching virtually every citizen's pocketbook."[3] Foot-and-mouth disease, the most contagious livestock disease known, is a likely pathogen a terrorist might choose to conduct an attack.[4] An outbreak of foot-and-mouth disease could cripple the U.S. livestock industry, devastate consumer confidence, and cause untold billions of dollars in losses. Moreover, the United States and its allies have faced a world-wide terrorist network whose active aim is to inflict great harm on the United States. Consequently, the United States must act now. An agroterrorist incident involving foot-and-mouth disease is a serious threat to U.S. national security. Federal, state, and local governments and agencies must accelerate their efforts to prepare for a possible attack.

The Virus

Foot-and-mouth disease is the world's most important and contagious animal pathogen. The World Organization for Animal Health defines it as a "List A" disease. List A diseases are "transmissible diseases that have the potential for very serious and rapid spread, irrespective of national borders, that are of serious socio-economic or public health consequence and that are of major importance in the international trade of animals and animal products."[5] Foot-and-mouth disease is a virus that has the remarkable ability to survive in carcasses, animal byproducts, water, straw bedding, and pastures. It can withstand freezing temperatures and cling to clothing, vehicles, and farm implements. While it is a viral disease of cattle and swine, foot-and-mouth disease also affects sheep, goats, deer, and other cloven-hoofed animals. There are seven separate types and as many as 70 subtypes of the foot-and-mouth virus. Infected animals develop large, painful blisters in the oral cavity and on the feet and exhibit signs of depression, anorexia, lameness, and salivation. With an incubation period of two to twenty-one days (three to eight days is the

average), foot-and-mouth disease can spread up to 60 km overland and 300 km by sea as an aerosol on the wind. Found in 31 countries throughout South America, Africa, Asia, and Europe, foot-and-mouth disease is the virus that causes the greatest concern amongst farmers and agricultural regulators.[6]

Foot-and-mouth disease is not a new phenomenon, nor are the anti-livestock programs that have focused on this particular disease. Examples of anti-livestock weapons programs were evident throughout the twentieth century and continue today. During World War I, the allies found "incontrovertible" evidence that German agents inoculated horses and cattle leaving U.S. ports for shipment to Europe with disease producing bacteria.[7] In World War II, the Germans took an active interest in countering the foot-and-mouth disease threat to their own cattle while they explored possible foot-and-mouth disease uses as an offensive weapon. Defensive vaccine production began in 1940, and by 1943, the Germans experimented with foot-and-mouth disease distribution by dropping little bunches of infected grass or hay at specific heights in order to create an "inconspicuous dispersal."[8]

Early in the Cold War, the Soviet Union's Ministry of Agriculture created its own successful biological weapons program. Under a special anti-livestock weapons division known as the "Main Directorate for Scientific and Production Enterprises," the Soviets created a biological warfare (BW) program code-named "Ecology."[9] Here scientists developed different variants of foot-and-mouth disease and explored ways to spray the viral agent from tanks attached to Ilyushin bombers flown low over a target area along a straight line for hundreds of miles.[10]

Today, biological weapons research continues around the world. At least twenty nations are suspected of pursuing offensive biological warfare capabilities with eight high-profile nations topping the list: Iran, Iraq, Israel, North Korea, China, Libya, Syria, and Taiwan.[11] While these countries might not carry out an agroterrorist act against another nation, they could conceivably sponsor a terrorist organization and supply it with the foot-and-mouth disease pathogen.

Obtaining the foot-and-mouth disease virus from a state with an active anti-livestock biological weapons program is but one of three basic ways a terrorist can acquire an animal pathogen. A terrorist can also isolate the organism from the environment, or attempt to order it from a biological collection or a laboratory. Of the three methods, obtaining a foot-and-mouth disease sample from the environment is probably the

easiest.[12] While a terrorist might be able to find a state sponsor, he might also encounter states reluctant to lend their support for fear of U.S. retaliation after an agroterrorist event and especially since the United States declared war on terrorists and their supporters in late 2001. A terrorist will struggle even more to obtain the foot-and-mouth disease virus from a U.S. biological laboratory. The virus is not held in state veterinary laboratory collections in the United States. The Plum Island Animal Disease Center in New York is the only lab in the country that studies foot-and-mouth disease, and it keeps this highly contagious virus under very close control in its "Foot-and-Mouth Disease Unit."[13] Therefore, a terrorist will probably turn down the path of least resistance and look to the environment for his virus sample.

Unlike deadly human pathogens like those causing Ebola and other hemorrhagic fevers that are difficult to isolate from the environment, animal diseases are far easier to obtain and cultivate. A terrorist could travel to any one of the 31 countries in which foot-and-mouth disease is endemic, purchase an infected animal, and with a "rudimentary knowledge" of microbiology, obtain a sample of the pathogen for intentional introduction into our herds.[14]

Following the acquisition of the virus, no special process is required to weaponize the agent. The animal pathogen only has to come in contact with the target host to cause infection. Thus, once a terrorist has the foot-and-mouth disease virus in hand, his next concern will be to find a way to spread the disease and carry out his attack.

There are several ways the highly contagious and survivable foot-and-mouth disease virus is transmitted during an outbreak. The virus can be transmitted via direct or indirect contact (droplets), animate vectors (humans or animals), inanimate vectors (vehicles or implements), or through the air in a fine particle aerosol form.[15] While a terrorist could conceivably use any of these means to spread the disease, he is likely to use either direct/indirect contact in the form of droplets or cell material, or he might use an aerosol for rapid dispersal over a larger area. He would probably avoid close human or vehicle contact with a target area to decrease his risk of being detected, and instead rely on natural means of transmission to help spread the disease following the initial outbreak.

Since foot-and-mouth disease is capable of virtually uncontrollable spread on its own, a terrorist would not need any special dispersal devices to execute his attack. With something as simple as a "VIP" (vial in pocket), a terrorist could set off an epidemic with relative ease.[16] In an

attack on the swine industry, for example, a terrorist could take a sample of tongue epithelium from an animal infected with foot-and-mouth disease and place it in the air intake of a large hog operation.[17] Or, in an assault against the dairy and beef industry, imagine the following chilling scenario:

> A terrorist arrives in the nation's capital armed with a weapon obtained by scraping off lesions from the blistered tongue of an African cow with hoof-in-mouth disease (foot-and-mouth disease). With several million particles of virus stored in a lunch cooler, he rents a car at Dulles International Airport outside Washington and drives south into the Virginia countryside. At several farms, he stops where cows or horses stand near fences and, using wads of cotton, calmly rubs some of the virus into their nostrils. By the time he reaches Richmond, an epidemic is virtually assured.[18]

Perhaps the most frightening scenario, though, where the greatest number of animals could be infected takes place at the cattle feedlot. With some of the largest feedlots today holding between 300,000 and 800,000 cattle, an intentional introduction of foot-and-mouth disease would be catastrophic. Not only would hundreds of thousands of animals be lost at the feedlot, but countless thousands of other animals would also be infected and destroyed across the country. Considering that a single feedlot ships up to 10,000 cattle a day to slaughterhouses and other production facilities where infected animals would get the opportunity to mingle with other animals, it would not take long for a terrorist to make a huge dent in the U.S. livestock industry.[19]

Possible Terrorists

Any number of nations around the world might have an incentive to carry out a vicious agroterrorist attack against the United States. A nation like Iraq, for example, might send an agent to spread foot-and-mouth disease throughout the United States in an act of revenge after ten years of economically crippling sanctions. Or, a nation like China might execute a clandestine act of economic sabotage against the United States in an

attempt to bolster their markets and economy. By smuggling some foot-and-mouth disease infected pigs into California, China could cause the U.S. swine export trade to come to a halt and then step in to fill the market gap. Many Taiwanese suspect that the mainland Chinese regime conducted this type of attack against their nation in 1997 when Taiwan lost eight million hogs to this disease and over fifteen billion dollars in export trade. Whether this was a true act of sabotage or a natural disease outbreak is still open for debate.[20]

In addition to the threat from various nations hostile to the United States, criminal or terrorist groups also pose a danger to the U.S. agricultural sector. An organized crime syndicate, anxious to control commodity and futures markets, might turn to agroterrorism, or a Colombian drug cartel might carry out foot-and-mouth disease attack to "retaliate in kind" after U.S. operations against their narcotic-producing crops.[21]

Since the mass casualty terrorist events in New York and Washington, D.C. led by Al Qaeda terrorists, financed and directed by Osama bin Laden, the U.S. Government has been on a heightened alert status against terrorist acts of all kinds.

Since U.S. farms and farm animals are such key assets and potentially so very vulnerable to agroterrorist attacks, U.S. homeland security officials and programs should be especially active in providing a bio-defense of such rural assets against the Al Qaeda bioterrorism threat.

Nor are these the only possible set of terrorist threats to U.S. agricultural assets. Militia groups in the Pacific Northwest might also turn to bioterrorism against agriculture to fulfill the teachings of the *Turner Diaries*, while millennial groups might unleash a foot-and-mouth disease attack as their contribution to societal collapse.[22] Perhaps future agroterrorist attacks will come from those organizations that already have experience striking U.S. agricultural facilities. Extremist environmental protection and animal rights groups conduct hundreds of a variety of types of attacks a year in the United States, Canada, and Britain to make a statement against the use of genetically engineered crops and animals.[23] An attack using a virus like foot-and-mouth disease would give one of these groups plenty of media attention without having to kill a single human being.

The final type of terrorist who might intentionally infect U.S. livestock with foot-and-mouth disease is the individual perpetrator. This category might include fanatics devoted to a particular issue or people

seeking revenge or economic gain. In an age where politically motivated terrorism appears to be in the decline and terrorism carried out in the name of a particular religion is on the rise, it would not be unusual to see a religious zealot strike out against the United States in the form of an agroterror attack.[24]

Individuals like Ted Kaczinski, the schizophrenic "Unabomber," might surface as well. Instead of holding a grudge against the industrial system, the next "Kaczinski" might be anxious to inflict pain, for whatever reason, on the agricultural system. Disgruntled employees from the agricultural sector or speculators on the commodities market could also capitalize on an agroterrorist incident.[25] Regardless of their reasons, each of these individuals will find U.S. livestock an extremely vulnerable and attractive target.

Foot-and-Mouth Disease's Appeal as a Weapon of Choice

The U.S. livestock industry might represent the ideal target for future terrorist attack using a biological agent. Agroterrorism, using the foot-and-mouth disease virus for example, has tremendous appeal because it is non-threatening to the terrorist, relatively easy to accomplish, and can produce a devastating effect on the target. The use of foot-and-mouth disease in an agroterrorist act is non-threatening to the terrorist for several reasons.

First, unlike lethal human pathogens, foot-and-mouth disease is harmless to human beings. A terrorist can obtain a sample, hand-carry it to a target farm or feedlot, and distribute it without having to worry about infection.[26]

Second, after introducing the foot-and-mouth disease virus, a terrorist would not have to worry very much about being apprehended. The risk of detection after an agroterrorist attack is low because health authorities will undoubtedly find it extremely difficult to differentiate an intentional act from a natural outbreak.[27] Even if the U.S. Government can somehow determine that a terrorist caused the foot-and-mouth disease outbreak, the average three to eight day incubation period will give a terrorist plenty of time to leave the country before the first signs of the disease appear.

On the off chance that U.S. authorities can track down and apprehend the terrorist – if he or she is a U.S. citizen, the terrorist is likely to face a light penalty. Under section 43 of title 18 of the U.S. code, anyone who causes economic damage in excess of $10,000 to an animal enterprise can only be jailed for up to one year and forced to pay the appropriate agricultural damages.[28] Whether caught or not, the agroterrorist currently has little to fear when carrying out an isolated attack. On the other hand, if he or she is implicated in a larger terrorist operation like Al Qaeda, then it would be a different, more serious outcome. Those caught would then be subject to a military tribunal, and, if an American citizen, can be charged with treason. That could lead to a far more severe penalty.

If relatively risk-free to the terrorist, a foot-and-mouth disease attack might be also quite easy to accomplish. Since the highly contagious and hearty foot-and-mouth disease virus can be found throughout the world, it is easy to obtain and ultimately quite simple to dispense the pathogen. A terrorist would only need enough microbiological expertise to recognize the symptoms of the disease in an infected animal, obtain a sample, and maintain the material in an infectious state during transport. Infectious material can come in the form of fluid from a blister, fecal material, or a tissue sample from the deceased animal.[29]

Once the terrorist has the foot-and-mouth disease virus in his possession, he or she can travel to any number of sites to distribute the biological weapon with ease. After all, agricultural facilities are "soft targets" with little or no security protecting them.[30] Farms, feedlots, slaughterhouses, and auction houses have very low security, while pastures and fields have essentially no security at all.

If, for some reason, those tempting objectives seem too risky, a terrorist can even attempt an attack from outside the target nation. Many countries today import agricultural materials like straw and animal feed. If a terrorist were to infect these items with foot-and-mouth disease before they were exported, he could potentially cause multiple outbreaks once these materials were distributed to their various destinations.[31]

Last, while a foot-and-mouth disease attack might be physically easy for a terrorist to execute, it is psychologically "palatable" as well. Infecting animals with a disease presents fewer "ethical quandaries" for a terrorist than infecting human beings.[32] The Aum Shinrikyo cult in Japan had to deal with this dilemma after one of its members developed "cold feet" while carrying out a biological attack. Apparently, the individual failed to arm a biological weapon because he suddenly realized that

attacking innocent people was wrong.[33] It is much less likely that an agroterrorist would suffer from a similar bout of morality when he unleashes the foot-and-mouth disease virus.

Safer and relatively easier to attempt, agroterrorism is also appealing because it could inflict such devastating effects on the target nation. To make matters worse, a terrorist armed with the foot-and-mouth disease virus can produce these disastrous physical and psychological effects with minimal effort.[34] One small outbreak can cripple an economy and destroy consumer confidence virtually overnight. Consider the 2001 foot-and-mouth epidemic in the United Kingdom. What started out as a natural outbreak of foot-and-mouth disease at a small pig farm quickly spread to over 900 locations throughout England, Scotland, and Ireland.[35] In the meantime, life in the UK came to a standstill, while the beef industry, already shaken by "mad cow" disease, had to somehow recover from yet another staggering blow.

A terrorist could achieve similar results by intentionally infecting just a small number of farms or feedlots with foot-and-mouth disease. A limited outbreak would decimate a nation's livestock industry with trade embargoes, lost revenues, the wholesale loss of herds, and carcass removal and disinfection costs. In addition, consumers would likely turn away from a product considered tainted with disease and not resume buying it for weeks or months.[36]

If a limited outbreak of foot-and-mouth disease were to occur in the United States – one that affected only about 10 farms and was quickly diagnosed and eliminated – the estimated overall loss would still be in excess of two billion dollars.[37] Unfortunately, the United States is highly susceptible to both small outbreaks and full-scale epidemics.

The United States as a Target

The 2001 Al Qaeda kamikaze attacks with hijacked airliners against two skyscrapers in New York City, the similar attack on the Pentagon building, the aborted airliner attack downed in Pennsylvania, the subsequent anthrax attacks on targets using the U.S. mail system, and the revelations about Al Qaeda attempts to secure weapons of mass destruction (i.e., nuclear explosives, radiological bomb, chemical arms, and biological weapons) all have sounded the alarm. The United States is

no longer a sanctuary and some of its key assets are at risk in its war with terrorism.

To the terrorist, the United States must appear to be a target rich environment. At risk might be our major urban centers, our political leaders, our power grids and communications centers, key dams and nuclear power plants, military bases, and symbols of U.S. power like Wall Street, the White House, the U.S. Congress, the Pentagon, and the Department of State. Of equal importance is the United States agricultural sector, and agroterrorism could pose a major threat to it. When and if a major agroterrorist attack does occur somewhere in the world, there is good reason to believe that it will take place on U.S. soil.

The United States is extremely vulnerable and a "high risk" nation for several reasons. To begin with, the U.S. Government and the general public are just becoming familiar with the concept of agroterrorism and funding for defensive preparations is limited. Consequently, the threat of an anti-livestock "Pearl Harbor" is very real.

According to Randall Murch, the FBI's Deputy Assistant Laboratory Director for Investigative Technologies, "The public understands a terrorist attack on the Olympics, but not on someone's farm."[38] Most Americans have enjoyed safe, abundant food supplies their entire lives and are largely unaware of any internal or external threats.

An examination of congressional appropriations for agricultural counter-terrorism programs in the fiscal year 2001 budget reflects a lack of appreciation for the growing threat. For fiscal year 2001, before September 11, 2001, Congress appropriated $10 billion to fight terrorism, but only $6.5 million of that total went to U.S. Department of Agriculture (USDA) counter-terrorism programs.[39] Congress devoted less than one tenth of one percent of the counter-terrorism funds to combat what many experts believe is a disaster waiting to happen.

Since the United States-led war on terrorism was declared, after the September 11, 2001, attacks, the U.S. Congress appropriated an emergency counter-terrorism budget of $40 billion in the fall of 2001. It remains to be seen how much of that amount will be used to prepare biodefenses of the agricultural community. Several negative trends need to be reversed.

Budget woes in fiscal year 2001 had taken their toll on the team of experts needed to respond to a foot-and-mouth disease outbreak. The Animal and Plant Health Inspection Service (APHIS), the key agency responsible for protecting U.S. livestock against foot-and-mouth disease,

has seen its funding recently diminished. As a result, it has been forced to curtail its cadre of field veterinarians and animal pathologists who would respond to a crisis. According to Dr. Ty Vannieuwenhoven, a senior staff veterinarian with USDA-APHIS Veterinary Services, Emergency Programs, fewer veterinarians are in the field now than in 1984.[40]

Ironically, another vulnerability that makes the United States a likely target for foot-and-mouth disease agroterrorism can be attributed to the improved health and protection of American livestock. For example, because foot-and-mouth disease has been absent from the United States since 1929, animals have not developed an immunity to it nor have they been vaccinated against it.[41]

Therefore, any outbreak could result in the rapid spread of the disease throughout all sections of the country. In addition, American veterinary students get little to no education on the subject of foot-and-mouth disease due to the fact that it has been absent from the United States for over seven decades. Few students get the opportunity to train at the Plum Island foot-and-mouth disease laboratory, and few get the chance to travel to countries experiencing a foot-and-mouth disease outbreak. As a matter of fact, it is likely that most practicing veterinarians in North America would not be able to recognize a foot-and-mouth disease outbreak until large numbers of animals were infected and the disease was firmly established.[42]

New and improved methods of livestock production and processing have also created weak points in America's ability to defend its agriculture industry. Today, the U.S. utilizes "factory farming" which makes it extremely susceptible to a foot-and-mouth disease attack.[43] Factory fanning concentrates large numbers of animals in a few vulnerable locations. Swine farms and cattle feedlots routinely hold tens if not hundreds of thousands of animals each. This trend to consolidate herds to reduce overhead costs will only increase in the coming years. By the year 2010, agricultural experts predict that approximately 80 percent of U.S. livestock will pass through only two percent of the nation's feedlots, while only four meatpacking plants will process 80 percent of all animals slaughtered.[44] With such large concentrations of animals in just a few low-security locations, a highly contagious foot-and-mouth disease attack would clearly have devastating effects. The tremendous movement of livestock across the United States would also greatly facilitate the spread of foot-and-mouth disease. Today's food animals are extremely mobile and travel to numerous farms, feedlots, and ranches during a very short

time span. Cattle reared in the South, for example, might be fed or grazed in several states across the country before they are shipped to slaughter. In addition to animal transfers, the movement of people and vehicles and the sharing of equipment can contribute to a foot-and-mouth disease epidemic as well.[45]

Perhaps the most critical U.S. vulnerability to an agroterrorist attack is the sheer economic value of agriculture to the nation. The U.S. agriculture industry generates over one trillion dollars of economic activity per year and over $140 billion in export trade. According to Dr. Floyd Horn of the U.S. Department of Agriculture, if a terrorist introduced foot-and-mouth disease into cow-calf operations or feedlots, it would "disrupt the exports of beef almost immediately, like the day after."[46] Such a disruption would cause ripples throughout the United States and world economies. With 30 percent of the world's population fed by U.S. agriculture and 22 million American jobs directly or indirectly tied to the agriculture industry, people around the world would suffer from an agroterrorist attack in the United States.[47] The "domino effect" would extend beyond farms and slaughterhouses and severely impact restaurants, grocery stores, shipping companies, sporting events, tourism, and simple day-to-day outdoor activities. As Peter Probst from the Office of Special Operations and Low-Intensity Conflict in the Pentagon so aptly stated, an agroterrorist attack in the United States is an "irresistible temptation to those who wish to do us harm."[48]

The American people would likely feel the consequences of a major foot-and-mouth disease attack for several years. Dr. Corrie Brown testified before the Senate that if a terrorist introduced foot-and-mouth disease into the United States, the loss in export trade alone would be $27 billion. This figure does not include the extensive costs associated with disease diagnosis and surveillance, the depopulation, cleaning, disinfecting and quarantining of animals, or the direct, indirect and induced losses in the domestic economy.

Considering the fact that a foot-and-mouth disease outbreak in the United States could potentially impact 100 million cattle, 70 million swine, 10 million sheep, and many of the nation's 40 million cloven-hoofed wild animals, Americans could certainly expect an immediate and sustained increase in the price of food. Americans currently spend about nine cents out of every dollar for food, perhaps the lowest amount in the world. After an agroterrorist incident, that amount might jump to 20 to 25 cents out of every dollar.[49] The corresponding loss of disposable income

would cut into the average person's ability to spend money in stores, restaurants or on vacations.

Undoubtedly, the U.S. stock market and overall economy would decline in response to this cut in spending. Public confidence in the U.S. Government and the agriculture industry might also decline after a foot-and-mouth disease attack. As a matter of fact, it is not inconceivable that widespread panic might temporarily erupt. Senator Pat Roberts of Kansas feels this is a definite possibility and states, "At the hint of a snow storm or hurricane, grocery store shelves are emptied. Now, stop and think a minute about what a food scare would do to that [sic] all over the country, and think of the chaos that would occur."[50] After a foot-and-mouth disease attack, people would not go hungry in America, but they would definitely experience some physical and psychological effects for quite some time.

Government and private sector estimates paint a bleak picture of the aftermath of a foot-and-mouth disease attack in America. As valuable as estimates are, however, they still do not provide the "wake-up'' call that most Americans need regarding agricultural vulnerabilities and agroterrorist or agrowar threats. Hopefully the events of September 11, 2001, and the subsequent bioterrorist events in the United States will focus more attention and resources on this problem. Nevertheless, since most U.S. citizens have never experienced a foot-and-mouth disease outbreak during their lifetimes, they would be wise to learn from the unfortunate experiences of three other industrialized nations.

In 1983, for example, Italy experienced a small outbreak of foot-and-mouth disease. While internally it only cost the Italians 8,000 head of cattle at a value of $11 million, externally they lost over $120 million in export trade.[51]

The 2001 outbreak of foot-and-mouth disease in the United Kingdom was a disaster. In February 2001, the UK food industry alone was losing over $72 million a week, and the National Farmers' Union estimated that if the disease was not brought under control within three months, the costs to the food and farming industries would easily exceed $1.2 billion. Many people in the British Isles compared this foot-and-mouth disease outbreak to the one that devastated their economy in 1967-68. That crisis took eight months to control and resulted in the slaughter of almost half a million animals. Despite its best efforts to control the 2001 foot-and-mouth disease outbreak, Britain quickly earned the reputation as the "agricultural pariah of Europe."[52]

Finally, the most economically devastating outbreak of foot-and-mouth disease in recent years took place in Taiwan in 1996-97. Taiwan, a major supplier of pork to Japan, saw its lucrative ·export market literally disappear overnight following the diagnosis of foot-and-mouth disease. After four years, Taiwan had slaughtered eight million hogs and experienced losses in excess of $15 billion. Taiwanese officials also estimate that their hog trade will not recover for at least a decade. Americans should pay close attention to the Taiwanese disaster. While the United States is famous for its safe food supplies and reliable agriculture industry, Americans would be wise to note that Taiwan had the best veterinary services in Asia when they suffered a devastating foot-and-mouth disease outbreak.[53]

Today's Response

If a terrorist were to strike a U.S. farm today with the foot-and-mouth disease virus, federal, state, and local response plans do exist to deal with the crisis. During any foot-and-mouth disease agroterrorist attack, time would be one of the most critical factors. In a 1999 California risk assessment that examined the cost of delay in dealing with an outbreak of foot-and-mouth disease, estimates revealed that each day of delay would cost about one billion dollars.[54] Therefore, quickly identifying the presence of disease and accurately diagnosing the virus would be an absolute imperative. The following list outlines the basic priorities farmers, veterinarians, and emergency response teams would follow after an attack:

1. Identify attack and confirm the agent.
2. Develop a case definition.
3. Identify exposed or potentially exposed herds.
4. Control movement of animals and vehicles out of affected area.
5. Isolate, slaughter, and dispose of (or vaccinate) exposed herds.
6. Vaccinate around the outbreak, if possible.
7. Throughout the crisis, inform and educate public.[55]

The local farmers, feedlot operators, and veterinarians are the all-important first line of defense in this time-critical process. Quick recognition could contain and control an outbreak and prevent an economic disaster. Once the private practitioners determine they are dealing with an abnormal or foreign animal disease (FAD), they would call on the U.S. Agriculture Department's Animal and Plant Health Inspection Service (APHIS) Veterinary Services (VS) unit and its Emergency Program's (EP) staff for assistance.

APHIS is the lead agency responsible for the diagnosis and management of all suspicious agricultural disease outbreaks. It has a memorandum of understanding with every state and the Department of Defense to cooperate in disease emergencies, and it has the authority to seize property and eliminate all animal hosts within certain concentric quarantine zones. In the event of a foot-and-mouth disease agroterrorist attack, the APHIS-VS division would coordinate the entire emergency response plan with state veterinary officials, veterinary colleges, industry officials, the Department of Defense, the Federal Emergency Management Agency, the American Veterinary Medical Association, private veterinarians, and livestock producers. Part of the Animal and Plant Health Inspection Service's rapid response strategy would be to respond to the local veterinarian's call for help with a foreign animal disease diagnostician (FADD). Approximately 350 FADDs, specially trained federal, state, military, university, and private veterinarians, are strategically located throughout the United States and available to respond within 24-hours of a suspected outbreak. The FADD takes the samples and works with the Animal and Plant Health Inspection Service lab to get a diagnosis as quickly as possible. If the lab confirms the foot-and-mouth disease virus, Animal and Plant Health Inspection Service-Veterinary Services works with local and state authorities to contain, control, and hopefully eradicate the disease.[56]

If state and local authorities do not have the resources to contain and control the foot-and-mouth disease outbreak, Animal and Plant Health Inspection Service can call on the Regional Emergency Animal Disease Eradication Organization (READEO) for additional help. The United States currently has two 38-person READEO teams, an eastern and a western team, and they are each composed of Animal and Plant Health Inspection Service-Veterinary Services employees, state veterinarians, military support personnel, industry liaisons, and representatives from other units with Veterinary Services, Animal and Plant Health Inspection

Service, and the U.S. Department of Agriculture. The teams are available for immediate call-up and train regularly with field and tabletop exercises. Their last full-scale exercise took place in November 1998 when both READEO teams mobilized for one week together, with local and regional veterinary personnel, and the FBI in response to a simulated terrorist release of a foot-and-mouth disease-similar virus.[57] The only drawback to Regional Emergency Animal Disease Eradication Organization System is the small number of teams available. In a time when the number of READEO teams should be increasing, they have actually been decreasing. Down to just two teams in 2001, READEO boasted four teams in 1993 and as many as six in the 1980s.[58] Clearly this trend must stop. While most experts agree that the current APHIS/READEO system could respond adequately to a single point agroterrorist attack, a large scale or multi-point attack would overwhelm the current system.[59]

A new idea from the Oregon Department of Agriculture might relieve some of the pressure on the under-funded APHIS-VS division and the reduced number of READEO teams in the event of an agroterrorist incident. State veterinarian Andrew Clark recently developed the "V.E.T.T." – the Veterinary Emergency Team Trailer. When an emergency animal disease call comes in, the V.E.T.T. can respond anywhere in the state of Oregon in a matter of hours. Fully stocked with personal protective gear, personnel disinfection items, animal movement control items, premises decontamination items, and office supplies, the V.E.T.T. is a pioneering effort to be proactive when it comes to rapid response. While other states have yet to develop their own version of the V.E.T.T., they are watching Dr. Clark's program closely to see how well it performs.[60] This current initiative is definitely a step in the right direction, but more work must be done soon at the federal, state, and local levels. Hopefully, the September 11, 2001, terrorism attacks and the aftermath anthrax mail assaults will spur some added impetus to corrective measures.

Work Remains in Countering Agroterrorist Threats

With little doubt, the United States needs a total unified effort to successfully counter the future foot-and-mouth disease agroterrorist threat. The responsibility for prevention, protection, and response stretches from

Congress down to the farmers of America. The federal government, however, must lead the charge.

U.S. lawmakers must first change the basic definition of "weapons of mass destruction" in title 50, chapter 40 of the U.S. Code, "Defense Against Weapons of Mass Destruction Act." Currently, biological agents that do not cause illness or death to people are not included in this definition. Once Congress amends the definition and includes a foot-and-mouth disease attack as WMD terrorism, then it can stiffen the penalties for future agroterrorists.

Next, the President and Congress must seriously address agroterrorism in their domestic preparedness and homeland security initiatives. The creation of the new U.S. Office of Homeland Security under former Governor Tom Ridge should direct steps to improve bio-defenses against potential agroterrorist attacks. In October 1997, the President's Commission on Critical Infrastructure Protection failed to even mention agriculture in its discussion of domestic terrorism threats. During this same time frame, Senators Nunn, Lugar, and Domenici, in their "Domestic Preparedness Program," also neglected to address agroterrorism and consequently failed to provide any assistance to the agricultural community. Most recently, the Gilmore Commission conducted a "domestic response to terrorism" study for the Secretary of Defense in December 2000, and mentioned agroterrorism, but deferred exploring current efforts to counter this threat until 2001.[61] Especially in light of the Al Qaeda attacks in late 2001, future government programs and panels would be wise to move this agroterrorist concern topic to the top of their respective agendas.

In future budget plans, Congress must also appropriate more funds to national and international programs in the battle against foot-and-mouth disease agroterrorism. For example, the Cooperative Threat Reduction (CTR) program, an inter-agency effort sponsored by the Department of Defense to reduce the Soviet WMD proliferation threat, needs continued support. Approximately 10,000 scientists worked on agricultural biological agents in the former Soviet Union. After the economic implosion in Russia in the early 90s, the concern here in the United States became "brain drain" to potentially proliferate nations. To reduce the likelihood of their turning to nations like Iraq, Iran, and Libya for jobs, the U.S. developed programs, affiliated with the International Science and Technology Center (ISTC) to increase transparency through funding scientist-to-scientist collaborations. The USDA's Freedom Support Act

and the Special American Business Internship Training (SABIT) initiative are designed to put these scientists to work in the civilian sector.[62]

Domestically, the Executive Branch and Congress must also provide improved assistance to the USDA's Animal and Plant Health Inspection Service. Receiving less than one tenth of one percent of the counter-terrorism funds in fiscal year 2001, the USDA's lead organization responsible for protecting U.S. livestock against foot-and-mouth disease is in dire need of dollars. Thomas Frazier, the president of GenCon, a company that tracks international disease outbreaks and related genetic-research issues, has called on the U.S. Government to spend $350 million over the next four years to help the USDA and State agricultural agencies build up their infrastructure defense systems.[63] If approved, such a substantial funding increase would have an immediate, sweeping effect on training and agricultural defense programs at the federal, state, and local levels.

With more money, the Animal and Plant Health Inspection Service could bolster its cadre of field veterinarians, USDA inspectors, diagnosticians, and rapid response teams. In the event of a foot-and-mouth disease agroterror event, early detection, diagnosis, and response will be absolutely critical. To improve its current capabilities, APHIS is actively recruiting veterinarians from around the country to act as a "ready reserve" in the event of a foot-and-mouth disease outbreak.

In an emergency, Animal and Plant Health Inspection Service would bring these private practitioners onto the personnel rolls of the federal government where they would supplement the agency's existing employees for up to 60 days.[64] In addition to a reserve network of veterinarians, Animal and Plant Health Inspection Service also needs to hire more USDA inspectors to guard U.S. ports of entry against foreign disease agents. With only 126 inspectors handling the import of 16.7 million animals annually, and only 58 dog-detector teams patrolling U.S. international airports for illegally imported meats, the sheer volume of people and material overwhelms the current system.[65] Finally, Animal and Plant Health Inspection Service needs more money to create additional rapid response teams. The current APHIS-Veterinary Services system that relies on only two Regional Emergency Animal Disease Eradication Organization teams would be entirely insufficient to react to a multi-point foot-and-mouth disease attack. In addition to creating more regional emergency response teams, Animal and Plant Health Inspection Service should consider forming small teams to patrol U.S. farms and feedlots on a

regular basis.[66] Helping the local farmers detect a foot-and-mouth disease outbreak in its early stages would likely contain the virus and prevent a nationwide epidemic.

Improved federal funding will also allow Animal and Plant Health Inspection Service to accelerate its current foot-and-mouth disease vaccine and diagnostics research at the Plum Island facility in New York. In the past, foot-and-mouth disease vaccines have been problematic for several reasons. Traditionally, scientists have had difficulty developing foot-and-mouth disease vaccines because the pathogen mutates and changes its surface from year-to-year. In addition, foot-and-mouth disease exists as a virus with seven serotypes and 70 subtypes, and a vaccination against one type does not guarantee protection against another. Furthermore, veterinarians cannot easily distinguish a vaccinated animal from an infected animal, although a test is now available to do so.

Therefore, to completely eliminate the disease, farmers would ultimately have to destroy both infected and vaccinated animals. Today, the Plum Island Animal Disease Center is working on chimeric vaccines that have components of two foot-and-mouth disease virus serotypes and on a drug that can prevent foot-and-mouth disease virus replication. Its scientists are also conducting research on vaccination with parts of the foot-and-mouth disease virus that may lead to vaccines that do not cause the disease. Until researchers at the Plum Island facility make further progress, however, the Animal and Plant Health Inspection Service will maintain a relatively small vaccine stockpile for emergency use only. In the event of a widespread outbreak or epidemic, so long as the supply holds out, the foot-and-mouth disease vaccine would enable the Animal and Plant Health Inspection Service to set up a buffer zone and limit the spread of the disease.[67]

In addition to vaccines, diagnostic tests are becoming better, faster, and can now be conducted on the farm. Continued improvement in test sensitivity and ease will greatly facilitate the rapid identification of infected herds, thereby, allowing them to be destroyed before they can infect neighboring herds. Maintaining a strong research tech base is critical to dealing with the unknown. We must continue to build our research programs at Plum Island, the other U.S. Department of Agriculture labs within the country, and at agricultural universities. Such research is dual-use in that it will prepare us to deal with a naturally occurring outbreak or a terrorist event.

Together with increased Congressional funding, Animal and Plant Health Inspection Service needs to receive more help from the Defense Department in its preparations to limit the effects of any future foot-and-mouth disease agroterrorism. The Department of Defense has had a long-standing relationship with the Department of Agriculture, but most of that interaction has involved training at the veterinarian level. The Animal and Plant Health Inspection Service has trained more than 75 military veterinarians on the recognition and treatment of foreign animal diseases and continues to train more on an annual basis. The two departments also have a Memorandum of Understanding (MOU) dating back to 1964 in which the Defense Department agrees to assist the Agriculture Department in the event of biological contamination to the U.S. agricultural base. The last major test of this MOU occurred in 1983 when the Pentagon supplied manpower and equipment to help clean up an Avian Influenza outbreak in Pennsylvania.[68]

Today, with the growing threat of agroterrorism, the Defense Department, and in particular, the National Guard, should play a more prominent role in responding to a biological attack against agriculture. While the National Guard has attempted to form and train Weapons of Mass Destruction Civil Support Teams for a chemical/biological attack against humans, the Guard has yet to form a similar team to offer support in the event of agricultural attacks. Some members of the U.S. Senate believe that with the proper training, these initial response teams could "cross over" and help out the Animal and Plant Health Inspection Service with rapid diagnosis, containment, and eradication during a foot-and-mouth disease attack. After three years and $143 million, however, the National Guard has yet to produce a team ready to respond to a chemical/biological attack against humans, let alone train a team to help out with an agroterrorist event.[69]

While increased assistance from the Department of Defense or Homeland Security Office to fight agroterrorism would certainly be helpful, increased awareness and stronger bio-security measures among farmers and private industry are absolutely essential. Most farmers and members of the agriculture industry have never seen an animal suffering from foot-and-mouth disease and would be hard-pressed to identify a case if they saw one. Dr. Corrie Brown, College of Veterinary Medicine at the University of Georgia, recommends that the U.S. Agriculture Department distribute pamphlets to agricultural field personnel, which describe various types of foreign animal diseases. Dr. Brown would also like to see the

Animal and Plant Health Inspection Service develop a "1-800 Hotline" for reporting suspicious diseases and more mobile response units like Dr. Clark's V.E.T.T. program in Oregon.[70]

As for local bio-security measures, agricultural personnel need to employ better safeguards and security at farms, feedlots, and warehouses. Locks, perimeter fencing, and surveillance equipment might not prevent an agroterrorist attack, but they might make one more difficult to accomplish. Farmers would also be wise to quarantine all newly arriving animals to check for possible foot-and-mouth disease infection. Many ranches or feedlots utilize a quarantine system today. Without such a system, all new arrivals would immediately be mixed with thousands of other animals greatly facilitating the chance for disease transmission.[71]

Heightened awareness of the threat and some basic security measures are state and local responsibilities that might deter or at least control a terrorist foot-and-mouth disease assault.

In summary, in the past decade, the United States has increasingly been a target of terrorists, particularly the target of Islamic radicals such as the Al Qaeda terrorist organization led by Osama bin Laden. They have inflicted damage on U.S. Embassies in Kenya and Tanzania. They have aided terrorist attacks on the USS Cole and anchored off Yemen's coastline. They have initiated two separate attacks on· the World Trade Center – one in 1993 and a most disastrous mass casualty strike on September 11, 2001, the same day a hijacked airliner was used to ram the Pentagon. Subsequent to September 11, 2001, a spate of anthrax-laced letters were sent through the mail to U.S. Senators, to the U.S. Department of State, to the Governor of New York, and to certain media offices in Florida. In the subsequent U.S. War on Terrorism that reached into Afghanistan, much information has been documented that showed Al Qaeda interest in acquiring weapons of mass destruction. A bioterrorist attack using foot-and-mouth disease on U.S. livestock could be devastating and acute biodefense measures are needed to protect the U.S. livestock food supply that is so vital to the United States. The agroterrorism threat posed by a foot-and-mouth disease attack could inflict such catastrophic costs unless negated by timely U.S. biodefensive programs. It is time to take urgently needed remedial measures to protect these vital assets.

Conclusions

Biological warfare against animals is not a new concept, but the topic of foot-and-mouth disease agroterrorism is a recent development. Foot-and-mouth disease research took place in World War I and II and was the focus of 10,000 Soviet scientists during the Cold War. Today, terrorists might be conducting their own foot-and-mouth disease research, and this possibility should cause tremendous concern within the United States. Unfortunately, though, very few people are familiar with the foot-and-mouth disease threat.

According to Dr. Floyd Horn of the U.S. Agriculture Department, "Agriculture simply has not been the focus of our national attention in biological weapons preparedness, even though it is the foundation of our national security, the repository of our national wealth, the basis of our pre-eminence in the global marketplace, and the sustenance of our rural economy and ideological psyche."[72] Foot-and-mouth disease is one of the most highly contagious viruses known to man and is capable of almost uncontrollable spread. In the hands of a terrorist, this biological weapon could severely damage the U.S. economy. Sadly enough, there are people in the world today who have the desire to harm the United States, and the foot-and-mouth disease virus is an easy agent to obtain and disseminate. To make matters worse, the United States, a free society, is an extremely vulnerable target making it more a question of *when* rather than *if* a foot-and-mouth disease attack will occur.

To counter this increasing threat, federal, state, and local agriculture personnel have developed some solid agroterrorism prevention and response initiatives. Congressional funding, however, has been lacking in coping with possible agroterrorism. While the current Animal and Plant Health Inspection Service infrastructure might be sufficient to counter a single point attack on one location, a multi-point attack could easily overwhelm its current system. Congress must appropriate monies and federal, state, and local agencies must team their resources and minds to prepare for an inevitable and perhaps imminent foot-and-mouth disease terrorist attack. Without immediate action, the United States may be setting itself up for an economic catastrophe. In the words of Dr. Jon Wefald, Kansas State University President, "The vision of National Guard troops having to machine-gun tens of thousands of diseased cattle in Kansas' feedlots doesn't present a pretty picture."[73]

Oftentimes in history it takes a disaster or tragedy of epic proportions to trigger a change in an organization, a town, or a nation. After witnessing the past foot-and-mouth disease crisis in the UK, Taiwan, and Italy, the United States should take heed and learn a valuable lesson from their problems. As we become more aware of the various threats to the United States and its allies in the post-September 11, 2001, world, we need to get out in front of the major biological warfare or bioterrorist threats that may be posed and should not leave ourselves vulnerable to the huge threat posed by a possible foot-and-mouth disease on U.S. livestock.

Notes

1. "New cases of foot-and-mouth disease confirmed," *Montgomery Advertiser*, 26 February 2001, 8; "Foot-and-mouth outbreak starts panic," *Montgomery Advertiser*, 27 February 2001, 8A; "Fears over foot-and-mouth spark riots in Brussels," *Financial Times.com*, 26 February 2001, On-line, Internet, 27 February 2001, available from http://news.ft.com/news/worldnews/uk; David Evans, "Fears mount in Europe over foot-and-mouth disease," *Reuters*, 26 February 2001, On-line, Internet, 27 February 2001, available from http://dailynews.yahoo.com/htxlwl/nm/?4; Martin Fletcher, "Germany confiscates Britons' sandwiches," *The Times*, 27 February 2001, On-line, Internet, 27 February 2001, available from http://www.thetimes.co.uk/section/0,2,0.html; Kevin Connolly, "Ireland battens down the hatches," *BBC News*, 1 March 2001, On-line, Internet, 1 March 2001, available from http://news.bbc.co.uk/2/hi/europe/1196950.stm; Jorn Madslien, "Rising cost of farm crisis," *BBC News*, 1 March 2001, On-line, Internet, 1 March 2001, available from http://news.bbc.co.uk/2/hi/business/1196039.stm; "Europe-wide alert over farm virus," *BBC News*, 1 March 2001, On-line, Internet, 1 March 2001, available from http://news.bbc.co.uk/2/hi/europe/1195989.stm.

2. David Brown, "Ministry vets trace trail of infection," *Telegraph*, 27 February 2001, On-line, Internet, 27 February 2001, available from http://www.telegraph.co.uk/news/uknews/1324297/Ministry-vets-trace-trail-of-infection.html.

3. Senate, *Agricultural Biological Weapons Threat to the U.S.: Hearing before the Subcommittee on Emerging Threats and Capabilities of the Committee on Armed Services*, 106th Cong., 1st sess., 1999, 36.

4. Corrie Brown, "Emerging Infectious Diseases of Animals: An Overview," in *Emerging Diseases of Animals*, ed. Corrie Brown and Carole Bolin (Washington, D.C.: ASM Press, 2000), 2.

5. Office International Des Epizooties, "Definition for Lists A and B Diseases," On-line, Internet, 13 February 2001, available from http://www.oie.int/eng/maladies/en classification.htm.

6. Office International Des Epizooties, "Foot and Mouth Disease," On-line, Internet, 13 February 2001, available from http://www.oie.int; USDA Animal and Plant Health Inspection Service, "Foot and Mouth Disease," On-line, Internet, 12 February 2001, available from http://www.aphis.usda.gov/oalpubslfsfind.html; Office International Des Epizooties, "Disease Information," On-line, Internet, 28 February 2001, available from http://www.oie.int; Clarence M. Fraser, ed., *The Merck Veterinary Manual* (Rahway, NJ: Merck & Co., Inc, 1991), 338-40; Corrie Brown, "Economic Considerations of Agricultural Diseases," *Annals of the New York Academy of Sciences*, 894 (1999), 93; Floyd P. Hom and Roger G. Breeze, "Agriculture and Food Security," *Annals of the New York Academy of Sciences*, 894 (1999), 13; Peter L. Nara, "The Status and Role of Vaccines in the U.S. Food Animal Industry: Implications for Biological Terrorism," *Annals of the New York Academy of Sciences*, 894 (1999), 212.

7. Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare,* vol. I, *The Rise of CB Weapons* (New York: Humanities Press, 1971), 216.

8. Erhard Geissler and John Ellis van Courtland Moon, eds., *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, (New York: Oxford University Press, 1999), 114.

9. Ken Alibek, *Biohazard*, (New York: Random House, 1999), 37-38.

10. Ibid., 38.

11. Lt Col Robert P. Kadlec, "Biological Weapons for Waging Economic Warfare," *Battlefield of the Future*, On-line, Internet, 2 February 2001, available from http://www.airpower.maxwell.af.mil/airchronicles/battle/chp10.html.

12. Rocco Casagrande, "Biological Terrorism Targeted at Agriculture: The Threat to U.S. National Security," *The Nonproliferation Review* (Fall/Winter 2000): 93.

13. Ibid., 94; Plum Island Animal Disease Center, "ARS Research Units at Plum Island," On-line, Internet, 13 February 2001, available from http://www.ars.usda.gov/plum/ars.htm.

14. Casagrande, 94; Corrie Brown, "Economic Considerations of Agricultural Diseases," *Annals of the New York Academy of Sciences*, 894 (1999), 93.

15. Office International Des Epizooties, "Foot and Mouth Disease," On-line, Internet, 13 February 2001, available from http://www.oie.int.

16. Senate, 35.

17. Ibid., 35.

18. Steve Goldstein, "U.S. officials awakening to threat of agroterror," *The Dallas Morning News*, 27 June 1999, 13 February 2001.

19. Michael V. Durul, "The Threat of Bioterrorism to U.S. Agriculture," *Annals of the New York Academy of Sciences*, 894 (1999), 186; Dr. Jimmy Villard, "The Threat of Intentional Introduction of Foreign Animal Diseases into the United States," On-line, Internet, 28 February 2001, available from http://aphis.usda.gov/vs/ep/avmalavma-sym.html.

20. Patrick E. Tyler, "Pig Plague Ravages Taiwan and Many Blame China," *New York Times*, 19 April 1997, On-line, Internet, 22 February 2001, available from http://www.tibet.calwtnarchive/1997/4/20_2.html.

21. Casagrande, 100.

22. Ibid, 99; Mark Wheelis, "Agricultural Biowarfare and Bioterrorism," *Chemical and Biological Arms Control Program,* 1 February 2001, 5; On-line, Internet, 5 February 2001, available from http://www.fas.org/bwc/agr/attack.htm.

23. Wheelis, 5; Judith Miller, "U.S. Would Use Long Island Lab to Study Food Terrorism,'' *New York Times*, 22 September 1999, 4, On-line, Internet, 13 February 2001, available from http://www.fas.orglnuke/guide/usalfacility/docs/e19990922long.htm.

24. Peter S. Probst, "Terrorism Overview," *Annals of the New York Academy of Sciences*, 894 (1999), 154.

25. Wheelis, 6.

26. Ibid, 9; Terrance M. Wilson, et al., "Agroterrorism, Biological Crimes, and Biological Warfare Targeting Animal Agriculture," in *Emerging Diseases of Animals*, ed. Corrie Brown and Carole Bolin (Washington, D.C.: ASM Press, 2000), 33.

27. Senate, 29; Wilson, et al., 33.

28. Casagrande, 98.

29. Wheelis, 10.

30. Senate, 25, 29; Wheelis, 9.

31. Wheelis, 10.

32. Senate, 29.

33. Jessica Stem, "Apocalypse Never, but the Threat is Real," *Survival* 40, no. 4 (Winter 1998-99), 177.

34. Wheelis, 9.

35. "Brown: Outbreak 'under control'," *BBC News,* 1 April 2001, On-line, Internet, 1 April 2001, available from http://news.bbc.co.uk/2/hi/uk_news/1254262.stm.

36. Casagrande, 97.

37. Hom and Breeze, 14.

38. Linda Rothstein, "Oh no, not *another* weapon of mass destruction," *The Bulletin of the Atomic Scientists,* November/December 1999, On-line, Internet, 13 February 2001, available from http://www.bullatomsci.org.

39. Casagrande, 92.

40. Ibid, 93; Senate, 38; "APHIS recruiting veterinarians for deployment during a foreign animal disease outbreak," *Journal of the American Veterinary Medical Association,* 1 January 2001, On-line, Internet, 1 March 2001, available from https://www.avma.org/News/JAVMANews/Pages/s010101f.aspx.

41. USDA Animal and Plant Health Inspection Service, 3.

42. Senate, 38.

43. Lonnie King, "Roundtable Summary: A Domestic Legislative Agenda for Improving Food Safety and Safeguards from Terrorist Attacks on the U.S. Food Supplies and U.S. Agricultural Interests," *Annals of the New York Academy of Sciences*, 894 (1999), 229.

44. Wilson, et al., 42; Brad Roberts, ed., *Hype or Reality: The "New Terrorism" and Mass Casualty Attacks* (Alexandria, VA: The Chemical and Biological Arms Control Institute, 2000), 111.

45. Wilson, et al., 41, 43; Peter L. Nara, 207.

46. Senate, 24-25.

47. Ibid., 24.

48. Probst, 158.

49. Senate, 35, 38; Wilson, et al., 40; Hom and Breeze, 13.

50. Senate, 48.

51. Brown, "Emerging Infectious Diseases of Animals: An Overview," 2; Senate, 37.

52. Michael Mann, et al., "Lives and livelihoods laid waste by disease," *Financial Times.com*, 2 March 2001, On-line, Internet, 5 March 2001, available from http://news.ft.com; Felicity Spector, "Britain, the Isle of Contagion," *New York Times*, 3 March 2001.

53. Corrie Brown, "Emerging Infectious Diseases of Animals: An Overview," 3; Senate, 37; Hom and Breeze, 14.

54. "V.E.T.T. to the rescue of animal health in Oregon," 11 August 1999, On-line, Internet, 13 February 2001, available from http://www.oda.state.or.us/Informationlsow/VETT.html.

55. David R. Franz, "Foreign Animal Disease Agents as Weapons in Biological Warfare," *Annals of the New York Academy of Sciences*, 894 (1999), 103.

56. Department of Defense, *Proliferation: Threat and Response*, (Washington, D.C.: Office of the Secretary of Defense, January 2001), 65; Wilson, et al., 36-37; Dunn, 187; "Veterinary Services Emergency Programs," On-line, Internet, 1 March 2001, available from http://www.aphis.usda.gov/vslep; Anne Kohnen, "Responding to the Threat of Agroterrorism: Specific Recommendations for the United States Department of Agriculture," October 2000, 29-30, On-line, Internet, 18 February 2001, available from http://ksgnotesl.harvard.edu/BCSIA/Library.nsf/pubs/ESDP4Kohnen.

57. Kohnen, 30; Wilson, et al., 37; "Veterinary Services Emergency Programs."

58. John B. Adams, "The Role of National Animal Health Emergency Planning," *Annals of the New York Academy of Sciences*, 894 (1999), 74.

59. Casagrande, 93; Nara, 208.

60. "V.E.T.T. to the rescue of animal health in Oregon."

61. Casagrande, 93; Wilson, et al., 49; Hom and Breeze, II. Rothstein, n.p. Senate, 49; Gilmore Commission, "Second Annual Report of the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction," 15 December 2000, 39, On-line, Internet, 7 March 2001, available from http://rand.org/nsrd/terrpanel/terror2.pdf.

62. Casagrande, 101; Hom and Breeze, 14; Senate, 2, 17.

63. Thomas Frazier, "Natural and Bioterrorist/Biocriminal Threats to Food and Agriculture," *Annals of the New York Academy of Sciences*, 894 (1999), 5.

64. "APHIS recruiting veterinarians for deployment during a foreign animal disease outbreak."

65. "Special issue of *Businessweek* foretells of catastrophic animal disease outbreak," *Vet Network Newsletter*, 9 March 2001, On-line, Internet, 9 March 2001, available from http://www.vetnetwork.com.

66. Casagrande, 103.

67. Nara, 208-09; Roberts, 112-13; Kohnen, 16; Plum Island Animal Disease Center, "Selected Scientific Accomplishments," 1-2, On-line, Internet, 11 March 2001, available from http://www.ars.usda.gov/plum/accomplish.htm.

68. Senate, 16; Colonel William Inskeep, Department of Veterinary Pathology, Armed Forces Institute of Pathology, phone interview by author, 12 March 2001.

69. Senate, 20; "National Guard Anti-Terrorism Teams at Risk," *Washington Post*, 26 February 2001, On-line, Internet, 1 March 2001, available from http://ebird.dtic.mil/Feb2001/e20010226anti.htm.

70. Senate, 51.

71. Wilson, et al., 43; Casagrande, 102.

72. Hom and Breeze, 11.

73. Senate, 30.

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