One Health Newsletter

A quarterly newsletter highlighting the interconnectedness of animal and human health

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This newsletter is dedicated to enhancing the integration of animal, human, and environmental health for the benefit of all by demonstrating One Health in practice.

Intrusions and Infectious Disease Emergence

Milt Friend, MS, PhD

Aldo Leopold's opening commentary in the forward to *A Sand County Almanac* reflects the motivation of many to pursue wildlife conservation as a career choice, including my own efforts to combat disease on behalf of free-ranging wildlife populations:

"…There are some who can live without wild things, and some who cannot….
[I am] one who cannot." (Leopold 1949).

Thus, it is somewhat of a personal paradox that human intrusion into "wild places" is one of the factors associated with the current era of infectious disease emergence and resurgence and that much of my current concerns have shifted away from "wild places" to metropolitan areas. This outcome causes me to reflect on the human movement of Old World diseases such as smallpox and measles to the New World through "first contacts" associated with colonization. Today diseases such as HIV/AIDS and Ebola hemorrhagic fever are examples of outcomes from increasing human intrusions into "wild places". Species intrusions (human and others) will continue to be transport vehicles providing new opportunities for pathogens. I draw your attention away from species intrusions in "wild places", despite their importance, to those occurring in the places where most of us live: urban and suburban communities.

I do so because I feel the emerging role of human-built communities as "breeding grounds" for infectious disease emergence is grossly underappreciated. I also suggest that these areas are important "proving grounds" for the application of "One Health" principles as an approach for disease prevention and containment. As such, they afford learning opportunities for the integration of human, domestic animal, and wildlife health at a different dimension than current approaches.

My primary concerns are associated with two basic types of intrusions. The first involves the intrusion of new and expanding human communities into uninhabited areas utilized by free-ranging wildlife. The second type of intrusion involves the colonization and/or seasonal uses of these communities by free-ranging wildlife. Both situations will continue to increase in association with the increasing human population and landscape changes that displace wildlife from their historic habitat. In addition, the creation of favorable habitat within metropolitan environments independently attracts

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- **Palm Beach County Health Department**
- **Florida Department of Health**
- **University of Florida**
- **Kahn/Kaplan/Monath/ Woodall One Health Team**

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some wildlife that then adapt to these environments. The scope of these intrusions is such that a wide array of species from large carnivores to small rodents and diverse taxa such as birds, mammals, and reptiles are increasingly becoming part of our "neighborhoods". The collective importance for wildlife conservation is such that metropolitan areas are now an important component of the habitat base for sustaining global biodiversity. Indeed, some free-ranging populations of endangered species are currently limited to these environments.

Wildlife intrusions are not themselves the cause for concern. Instead it is the nature of metropolitan communities relative to the complexity of host populations present, the separation of and variability in health management for these different populations, and the resulting high potential for pathogen transfers between host populations. These considerations raise concern that metropolitan environments are increasingly developing "spawning grounds" for infectious disease emergence. Host populations present may include humans, free-ranging wildlife, zoological and private wildlife collections, agriculture and companion animals (including wildlife pets), and feral animals, among others.

Animal rabies in New York City's Central Park 2009-2010

Click here to view map.
http://www.doh.state.fl.us/Environment/medicine/One_Health/AnimalRabiesNYC.pdf

Lack of direct contact between different species groups provides little comfort relative to insect transmitted diseases and environmental contamination from feces and other discharges, including waste disposal and sewage treatment facilities, utilized by various species. This "mixing bowl" also provides exposure to environmental contamination by antibiotics and residues from other pharmaceuticals and personal care products that can alter both host susceptibility and pathogen evolution. In general, there is an absence of any coordinated approach for disease detection and reporting for many of the species groups beyond that independently carried out by specific interests. When infectious disease emergence is detected, timely response often is impeded by jurisdictional and social issues that serve to advance disease spread and establishment.

The wildlife ingredients within this "mixing bowl" are the most difficult to address because, unlike human and domestic animal health programs, there is no formal wildlife health infrastructure that links regulatory authorities, responsibilities for wildlife well-being, and disease reporting with dedicated agency programs for combating disease occurring among various wildlife populations. Instead collaborative efforts involving an informal coalition of various agencies, and interests, may become involved in any specific event. For example, it is common for the public to submit impaired wildlife to private sector wildlife rehabilitators. These individuals and programs have varying capacity to determine if infectious disease is involved or to prevent disease spread within their facilities.

A changing world requires changes in the traditional approaches for combating infectious disease emergence.

Wildlife agency (federal, state) knowledge of these impaired wildlife may not become known until multiple cases result in media coverage or assistance is sought from a disease diagnostic facility or other relative program. This occurred with West Nile fever in raptors in the Midwest. Such delays retard timely investigative responses and, depending on the disease involved, may have ramifications for human, domestic animal and/or wildlife health. This is not a criticism of wildlife rehabilitators but instead points out a component of society that could play a significant role in the early detection of novel infections and infectious disease emergence if integrated within a holistic infrastructure for infectious disease detection and reporting.

Milton Friend

The bottom line is that we live in a changing world that requires changes in traditional approaches for combating infectious disease emergence. Metropolitan communities loom large as places for focus because of the following projections:

1. Previously it took a few millennia for the number of people living in cities to reach 3 billion-this number of city dwellers will double within 50 years;
2. The year 2003 was the first in which more people lived in urban/suburban areas than rural ones;
3. By 2050 about three-fourths of the human population will live in cities and suburbs;
4. According to the United Nations, cities are to absorb nearly all human population growth over the next three decades;
5. The number of urban areas with over 1M people is expected to grow by 40% between 2000 and 2015; and
6. The speed of modern transportation and large cities being focal points for the global mixing of goods and people enhances opportunity for novel interfaces between potential host species and disease agents and for the spread of ensuing infectious disease outbreaks (e.g., SARS).

Society can ill afford to allow metropolitan areas to become focal points for the emergence and dissemination of zoonotic disease or to be distribution points for non-zoonotic diseases of wildlife.

Society can ill afford to allow metropolitan areas to become focal points for the emergence and dissemination of zoonotic disease or to be distribution points for non-zoonotic diseases of wildlife. Thus, there is a pressing need for “One Health” advocates to step forward and develop pilot projects to guide and demonstrate the way for minimizing such threats.

Dr. Milton Friend is an USGS Emeritus Scientist and the Founding Director of the USGS National Wildlife Health Center in Madison, Wisconsin.

Among his numerous publications are the Field Guide to Wildlife Diseases published in 1987 and a greatly expanded and updated 1999 revision co-authored with J.C. Franson, Field Manual of Wildlife Disease, General Field Procedures and Diseases of birds and the 2006 Disease Emergence and Resurgence: The Wildlife-Human Connection
http://www.nwhc.usgs.gov/publications/disease_emergence/index.jsp

One Health and Wildlife

Merel Langelaar, DVM, PhD, Thijs Kuiken, DVM, PhD, DACVP, Andrea Gröne, PhD, Joke van der Giessen, DVM, PhD

Pathogens do not recognize barriers of domestication and unless there is a specific species preference, pathogens might be able to circulate in and between different animal populations, including wildlife, and people. Therefore, healthy wildlife is a prerequisite for healthy humans.

Wildlife health is closely intermingled with human health and healthy wildlife is a prerequisite for healthy humans.

Wildlife diseases in the consultation room?

Wildlife diseases might not be the first to be written down in a differential diagnosis in the general practitioner's consultation room when she/he sees a patient. Even a veterinarian, trained to diagnose animal diseases, might not always think at first instance of wildlife as the potential source for disease. But wildlife health is closely intermingled with human health and awareness hereof is important for professionals of many different disciplines, including veterinarians and physicians.

How can wildlife diseases affect human health?

First of all, diseased wild animals may pose a threat to humans. One can think of foxes with rabies or mice that spread hantavirus infections. In 2008 a Dutch woman returned from a trip in Uganda and was hospitalized with disease symptoms. Alert medical staff rapidly suspected viral hemorrhagic fever. Sadly, the woman died from Marburg virus infection that she contracted from bats when visiting a large bat cave. In the case of vector-borne diseases, vectors feed on wildlife and transmit diseases to humans.

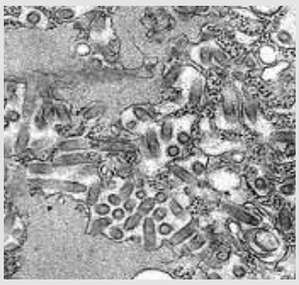
Egyptian fruit bats at home in the Python Cave, Maramagambo Forest, Queen Elizabeth National Park, Uganda. Courtesy CDC

Members of CDC's Special Pathogens Branch standing near harp trap preparing to capture fruit bats in the Python Cave in Uganda. Courtesy CDC

Diseased wildlife serves as a reservoir for pathogens that may infect domesticated animals which in turn may infect humans.

Secondly, diseased wildlife serves as a reservoir for pathogens that may infect domesticated animals and in turn may infect humans. One can think of *Mycobacterium bovis* spreading via badgers and wild deer to cattle, a problem in the UK. Avian influenza, which originates in wild birds, infects poultry and finally humans. Outdoor pigs contract trichinellosis or toxoplasmosis by ingesting wild rodents. Dogs contaminated with *Echinococcus multilocularis* by incidentally ingesting wild mice, subsequently excrete eggs that can infect humans.

A first step in the control of emerging diseases is raising the awareness of professionals from different disciplines.



Electron micrograph of the rabies virus
Courtesy CDC/Dr. Fred Murphy

Did the successful eradication of rabies lead to the spread of Echinococcus multilocularis in Europe?

Photomicrograph of a clustered *Echinococcus* sp. larval protoscolices in cut section of a hydatid cyst
Courtesy CDC

Thirdly, wildlife health itself is important to maintain biological equilibria. This is where ecologists come into the 'one health'-play. Surges in wildlife populations may lead to changes in an ecological system that might somehow push pathogens into a new niche. The spread of *Echinococcus multilocularis* in Europe might be an example of such a phenomenon. Although there is no scientific evidence for this, people have argued that one of the reasons for the expansion of this parasite is due to the successful eradication of rabies, the natural enemy of foxes.

Another example for the link between ecology and health is the spread of Lyme disease. Lyme disease in the Netherlands is a growing problem which has led to a strong increase in GP consultations and hospital admissions over the past decade. Transmission of *Borrelia burgdorferi* to ticks might be related to the biodiversity of host animal species. A dilutional effect on the vector is observed in a varied population of reservoir animals, as some animals are better hosts for the transmission to ticks than others.

Disturbance of wildlife populations is in large part provoked by human behavior, ranging from increased travel movements and deforestation to climate change and global warming. The consequences are emerging infections that threaten human public health and this might be the price we will have to pay.

Emerging infections

Of the emerging human infections that are yet to come, three-quarters are supposed to come from animals, primarily from wildlife. This is not a negligible number and demands preparedness. Although preparedness for the unknown is impossible, a first step in the control of such diseases is raising awareness of professionals from the different disciplines. This again asks for solid collaboration of these professionals, based on mutual trust and respect for each others' competence. Over the last three years, a consortium of Dutch institutes dedicated to animal and human public health have been asked to develop a blueprint of an early warning and surveillance system, that should help identify and control emerging zoonoses at the earliest stage possible. This collective effort demonstrates that working together in the one health concept, trying to control zoonotic diseases, is certainly feasible. However, it also demonstrates that there is still a ways to go before professionals from the field up to the policymakers and the government are aware of the threats of zoonotic diseases, and are able to disinterestedly exchange knowledge and data.

Knowledge gaps and solutions

One main problem in the collaborative effort to combat zoonoses is the absence of data. Notifiable diseases in production animals are closely monitored. Diseases such as salmonellosis, campylobacteriosis, trichinellosis, echinococcosis, and avian influenza have not all been eradicated from our livestock but at least we have a good picture. However, there is far less insight in diseases from horses, dogs and cats because surveillance systems are lacking. The same problem applies for wildlife health and disease. Some diseases are being monitored on a more regular basis (e.g. trichinellosis in swine, influenza in birds), or based on specific projects (e.g. hantavirus infections in wild rodents), but structural surveillance information has been lacking

However, since 2008 (informally since 2002), the Dutch Wildlife Health Centre (DWHC) has been established within the Department of Pathology of the Faculty of Veterinary Medicine of the Utrecht University. This centre investigates morbidity and mortality in wildlife in the Netherlands. The main task is the coordination of wildlife diseases

research, monitoring and education of veterinary students, hunters and other interested people . The centre reports yearly on its findings to the Ministry of Agriculture. The DWHC collaborates with other relevant parties involved in animal and human public health.

Neither pathogens nor wildlife respect boundaries.

Darkfield microscopy of *Borrelia burgdorferi*
Courtesy CDC

In parallel, many hunters, volunteers and civilians acquire information about (subpopulations of) wildlife. Official bodies (such as the DWHC, academia, and the national institute for public health and the environment) cooperate closely with these initiatives to obtain the latest data and to respond as soon as possible in case of a disease outbreak.

As neither pathogens nor wildlife respect boundaries, initiatives have been taken to coordinate wildlife monitoring and surveillance at the European level. People from the different wildlife health institutes gathered in Brussels last year to exchange information on how monitoring is set up in their country and a common goal was set to facilitate exchange of data. These wildlife specialists all came on a voluntary basis, accepting their responsibilities for the benefit of animal and human health.

Conclusion

Human health is closely related to wildlife health. The promotion of health goes beyond the (veterinary) medical profession but involves people from many different disciplines, including biologists, ecologists and epidemiologists. As human behavior strongly influences wildlife health, it also includes sociologists, anthropologists, climatologists and many more. Finally, policy makers will have to set out a policy in which all these people can work together for better health. Wildlife specialists, with a background in many different disciplines, are aware of their responsibilities in protecting wildlife and human health. They have already taken up the gauntlet.

***Ixodes ricinus*, a vector for Lyme disease in Europe**
Courtesy James Lindsey at Ecology of Commanster

The promotion of health goes beyond the medical profession. It also includes sociologists, anthropologists, climatologists, policy makers and many more.

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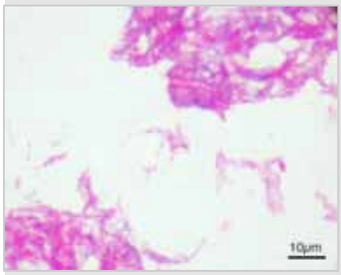
A field based approach to Bovine TB in England

Richard Gard



Mycobacterium bovis

For farmers, veterinary surgeons, and government, bovine TB is a frustrating, depressing, and expensive problem. There are some 85,000 cattle herds in Great Britain and just over 10% were restricted because of bovine TB in 2009. Of those herds that are restricted 80% are in England, 20% in Wales and very few in Scotland. A one tenth affliction doesn't sound like too much of a problem but, in England, the West Country holds over 80% of the restricted herds and in the far South Western counties one in four of all herds are restricted. Bovine TB is ruining milk and beef production through lack of progress with the disease and an increasing belief that the restrictions on livelihood will grow and grow.

Bovine TB is a frustrating, depressing, and expensive problem for farmers, veterinary surgeons and the government.

In any conversation about TB there is mention of 'hotspots'. These comments are generally clarified as 'hotspot counties'. The veterinary surgeons who carry out the testing on their client's farms identify hotspots within hotspots. Specific valleys, parishes or other particular areas are said to be 'rife' with TB. Some farmers identify groups of fields where cattle are grazed and then test failures follow. It is not surprising that bovine TB has increased in recent years. Our field based development group is working with farmers and their veterinary surgeons in local areas and a great deal is being clarified about this disease. It is this clarity that we invite you to scrutinise and comment upon.

A link between bTB infection in badgers and infected cattle was identified in the 1970's.

TB testing

European badger

Historically, bovine TB was kept under control through application of the Single Intradermal Comparative Cervical Tuberculin Test (SICCT), generally known as the TB skin test. Positive cattle were taken for slaughter and the farmer received compensation. The country became almost TB free, and twenty years ago the average duration of skin test failures with test and slaughter of the herd was six months. Now, with a similar test and slaughter scheme, the average duration of an outbreak nationally is twelve months. The test is a surveillance tool that identifies the TB positive herds effectively, so a positive is a positive, but in normal conditions the test leaves approximately 20% of positive animals undetected. Some herds in hotspots have failed the test repeatedly for several years.

The belief is that the current difficulties with TB in cattle are linked to the Foot & Mouth Disease outbreak in 2001 and the recent wet summers and mild winters.

Observations show that the herds in areas with healthy badgers do not have the problem of repeated bovine TB.

The badgers also need help to prevent the spread of TB in their population.

The primary aim of the tests is to capture the TB positive herds, place them under movement restriction to limit trading in infected cattle, and reduce spread of the disease from herd to herd. The test is therefore aimed at the herd, not the individual bovine and identifies infected animals not infectious or diseased animals. The latency effect of *Mycobacterium bovis* means that there is a period of infection before a positive skin test. This period is shorter with the gamma interferon laboratory blood test.

A link between bTB infection in badgers and infected cattle was identified in the 1970's. In 1992 it was made illegal to kill badgers, in order to stop badger baiting. Today farmers believe that they are open to criminal prosecution if they interfere with badger setts or kill badgers. The whole subject of badgers and TB is extremely sensitive and strong opinions are held. A project to cull as many badgers as possible, in an area of some two hundred farms in Wales, is due to commence as part of an extensive bio-security and testing approach commissioned by the Welsh Assembly. A Government programme of research to vaccinate badgers and cattle has been announced but the effectiveness of vaccination is expected to be low in populations harbouring the disease.

Our group, comprising a private veterinary surgeon with clients in the heart of a recognised bTB hotspot (Andrew Cobner), a wildlife assessor who has observed and monitored the situation with badgers and cattle for over a decade (Bryan Hill) and myself, have shared our understanding and experiences. The belief is that the current difficulties with TB in cattle are linked to the outbreak of Foot & Mouth Disease in 2001 and the wet summers and mild winters.

During the spring and summer of 2001, herds of cattle and flocks of sheep infected with the Foot & Mouth Disease virus were slaughtered together with contiguous herds and flocks. Badgers thrive on grazed, well manured grassland. Typically there will be higher populations of badgers on land grazed intensively by cattle, with dung pats and short grass. Fewer badgers populate land grazed by sheep and the activity of badgers is directly influenced by land management, grass length and stocking density. With the slaughter of the cattle herds went the plentiful food source for the badgers, that matched their population, and so traditional badger communities broke up. Increased fighting between badgers was observed and over the next two summers, as farming readjusted, the badgers established new territories but the stress had encouraged infected badgers to become infectious.

Recent summers have been very wet and extensive national flooding has been reported. Local streams have regularly risen and setts have been deluged, causing deteriorating conditions for animals living underground with a respiratory disease, and the numbers of unhealthy badgers has increased. It has become widespread for farmers to set up pheasant shoots as alternative income and the badgers enjoy food from the pheasant feeders throughout the winter. Until 2010 there have been mild winters and so a greater number of unhealthy animals survived.

Badger communities evict unhealthy animals. A healthy community marks their boundaries with latrines and unhealthy animals are driven beyond the boundary. These stressed badgers may link up with others or they may live a nomadic life until death. Some badgers are half sized, sickly animals that are afraid of their own kind. It is the unhealthy badgers that we believe spread disease to cattle.

A local area wildlife assessment and management approach to reduce bovine TB is new to the United Kingdom.

Richard Gard

The goal is "Healthy Badgers and Healthy Cattle."

Working in areas of ten square miles, the activity of the badgers, their territories and the location of unhealthy or 'skanky' badgers are assessed and their location matched on a map with the location of the cattle. The farm boundaries and land ownership cease to be important. Many farms have parcels of land separated from one another. The picture that this provides is extremely interesting to the farmers and their veterinary surgeons and offers a means of reducing the transfer of infection.

The planned programme is to achieve Healthy Badgers and Healthy Cattle. Our observations show that the herds in areas with healthy badgers do not have the problem of repeated bovine TB. Farmers do need healthy badgers and by participating in the work cattlemen have shown a willingness to co-operate in this, even if in nothing else. The badgers also need help to prevent the spread of TB within their population. In many TB hotspot areas healthy badgers are in decline.

Our group aim is to train more assessors, work in hotspot areas, involve veterinary surgeons in ongoing advice and to seek out and remove the skanky badgers. A film 'Bovine TB – The Way Forward' introduces the idea of identifying unhealthy badgers (www.chrischapmanphotography.com). We intend that the project is licensed by Government to remove the unhealthy badgers in an area, on one day, with trained people. A local area wildlife assessment and management approach to reduce bovine TB utilising skilled countrymen is new to the UK.

Further information is available at www.agmed.org.uk/projects.htm.

Richard Gard is a freelance writer and researcher who has had the luck to meet and work with some very able people. richard@agmed.hypermart.net

Bovine Tuberculosis in North American Wildlife: A Continued Risk

Ryan S. Miller, MS and Steven J. Sweeney MS, DVM

Mycobacterium bovis, has one of the widest host ranges of all known pathogens.

Mycobacterium bovis, the bacterium that causes the disease bovine tuberculosis (bovine TB), has one of the widest host ranges of all known pathogens, affecting many groups of mammals, including humans. In many parts of the world, bovine TB has become established in livestock and wildlife populations. Once established in wildlife, bovine TB can persist in these reservoirs of infection, frustrating efforts to eradicate the disease from livestock. In the United States, the economic impact of a wildlife (white-tailed deer) TB reservoir on the Minnesota cattle industry was estimated to be $3.25 million annually [1]. In Michigan, white-tailed deer hunting contributes as much as $506 million to the State's economy and has been adversely impacted by the presence of bovine TB [2]. The potential for severe economic costs to the livestock industry and to the recreational hunting industry requires action to prevent the establishment of new wildlife reservoirs of bovine TB in North America [3, 4].

Within North America it is thought that all of the current wildlife reservoirs infected with bovine TB were established as a result of contact with TB-infected cattle populations.

Within North America it is thought that all of the current wildlife reservoirs infected with bovine TB were established as a result of contact with TB-infected cattle populations. Worldwide this mechanism is common; contact with domestic animals has resulted in bovine TB becoming endemic in wildlife populations in New Zealand, Ireland, the United Kingdom, Hungary, Switzerland, and Spain [5]. In North America, bovine TB has been identified in nine distinct wildlife populations and is thought to be endemic in at least four of these populations. Bovine TB was only rarely reported prior to the 1990's among free-ranging ungulates in North America. In Canada, significant bovine TB infection was reported in 1942 in elk, moose, and mule deer in Buffalo National Park in east-central Alberta [6, 7]. Infrequent cases of bovine TB in wild deer were also reported in Ontario (1962) [8], New York (1934, 1963) [9, 10], Michigan (1975) [11], and Montana (1995) [12].

Historically, it was assumed that bovine TB would not persist in free-ranging deer or elk unless they had consistent contact with infected bison, cattle herds, or captive deer [13, 14]. This paradigm began to shift in the mid-1990s after bovine TB was identified in hunter-killed white-tailed deer in Michigan's northeast Lower Peninsula [11, 15]. Testing of hunter-harvested deer identified an endemic bovine TB infection in free-ranging white-tailed deer throughout Michigan's Lower Peninsula. Despite previous incidental findings of bovine TB in white-tailed deer in New York and Ontario, Canada, this population represented the first known reservoir of bovine TB in free-ranging wildlife in the United States and the first known epizootic of TB in white-tailed deer in the world [16].

Spillover from cattle to deer occurred around 1955 when Michigan's deer population was beginning to increase beyond normal carrying capacity

Epidemiologic models for Michigan estimate that spillover from cattle to deer occurred around 1955 when Michigan's deer population was beginning to increase beyond normal carrying capacity in response to increased demand for deer hunting [16]. In the region where bovine TB was found, deer densities had increased threefold during the three decades preceding the outbreak, and deer densities resulting from winter congregating were much higher [17]. Bovine TB was likely present within the deer population during this period and finally became evident when prevalence grew to detectable levels.

A similar situation currently exists in other North American wildlife populations. In Canada, elk were implicated in repeated outbreaks of bovine TB among cattle herds starting in 1991 surrounding Riding Mountain National Park in Manitoba [18]. However, bovine TB was reported as early as 1937 in plains bison and then again in 1978 in wolves, indicating that infection in wildlife may have persisted for many decades before being identified [19, 20]. It has been suggested that cattle may have originally exposed elk in the 1970's when cattle grazing within Riding Mountain National Park was common [21]. More recently, commingling of elk and cattle that feed on the same hay bales was considered the most likely mode of transmission between elk and cattle. In 2006, bovine TB was discovered in white-tailed deer in Minnesota in conjunction with an outbreak of bovine TB in beef cattle [4]. Testing of hunter-harvested deer in the vicinity of infected cattle herds identified a bovine TB-positive deer, and subsequent targeted culling and surveillance identified additional positive deer. Similar to Michigan, epidemiologic linkages between bovine TB-infected deer and cattle were supported by the proximity of deer and cattle cases and the similarity of the bovine TB strain in both species.

Feral Swine – An Emerging Threat to Eradication of Bovine Tuberculosis

Bovine TB has been isolated from feral swine in many regions of the world, including Australia, New Zealand, the U.S. Hawaiian Islands, Spain, and Italy [5, 16, 22-

26]. However, the role of feral swine in the epidemiology of bovine TB differs greatly by region and population. In Australia and New Zealand, feral swine are considered spill-over hosts, contracting bovine TB through consumption of infected buffalo and brush-tailed possums [23, 27]. In contrast, wild boars in Mediterranean ecosystems appear to be maintenance hosts of bovine TB, sustaining infection and transmitting the pathogen to other species [22, 28]. (Wild boars are the wild ancestors of, and same species as, feral swine). Circumstances favoring bovine TB transmission between wildlife and livestock in the Mediterranean region include artificial increases in wild game populations stimulated by a robust hunting industry, lack of natural predators, and intensive cattle grazing in game preserves in proximity to wildlife hosts [29].

While bovine TB has not been identified in North American feral swine…….

Courtesy Billy Higginbotham - Tex Agrilife Ext

While bovine TB has not been identified in North American feral swine, similar risks for disease emergence are present – high densities of feral swine, robust hunting industry, and significant baiting and feeding of feral swine. Feral swine have rapidly expanded their range in North America (figure 1), and there is real concern over their capacity for carrying and transmitting diseases that impact agriculture and human health [30]. Feral swine are the most abundant non-native free-ranging ungulate in North America, causing an estimated $800 million in damage annually to forests and farmlands. Historically, feral swine were restricted to the southern United States, but have spread northward and now are reported in at least 38 states and three Canadian provinces, nearly doubling the area occupied since 1988 [30]. Texas harbors approximately half of the estimated 5 million feral swine in the United States, with other major populations located in Florida, California, and Hawaii. Recently, feral swine have invaded many northern and Midwestern states including Michigan, Wisconsin, and Pennsylvania, where they represent a significant threat to animal agriculture.

……..the risks for disease emergence are present .

Establishment of feral swine populations is often associated with a demand for new game species by the recreational hunting industry. Feral swine are popular game animals; in many regions of North America domesticated pigs have been intentionally released and allowed to freely roam or have escaped from confined hunting operations. These animals can revert to their wild ancestral nature in as little as two or three generations [31]. Just as challenging is the illegal transport and release of feral swine across state lines for sport hunting [32-34]. In 2008, authorities in southern Colorado intercepted a trailer with 16 feral swine from Texas. Fourteen of the animals tested positive for pseudorabies virus, which is lethal not only to domestic pigs but also to sheep, cattle, dogs, cats, and some wildlife species. Similarly in Idaho, officials recently discovered a population of feral swine that had been transported and released for hunting. In Missouri, researchers found that new feral swine populations were statistically associated with public lands and concluded that hunters were illegally introducing feral swine to increase hunting opportunities [33]. Many of the newly established feral swine populations in northern and Midwestern states are attributed to introduction for sport hunting.

Many of the newly established feral swine populations in northern and Midwestern states are attributed to introduction for sport hunting.

Particularly worrisome is the recent appearance of feral swine in Michigan, where the potential exists for interaction with TB-infected white-tailed deer and cattle. Feral swine are often associated with white-tailed deer hunting clubs which, because of baiting and supplemental feeding of deer, have been a nidus of bovine TB infection in deer. Once a population of feral swine becomes established, it is extremely difficult to remove the animals. Prevention of domesticated swine escapes or intentional releases and timely elimination of new populations are currently the best management practices.

While controlling feral swine is difficult, it may be feasible to eradicate small, isolated populations before they become established. Land owners should make every ef-

At the strategic level, federal and state officials have called for the establishment of a coordinated, comprehensive feral swine control program.

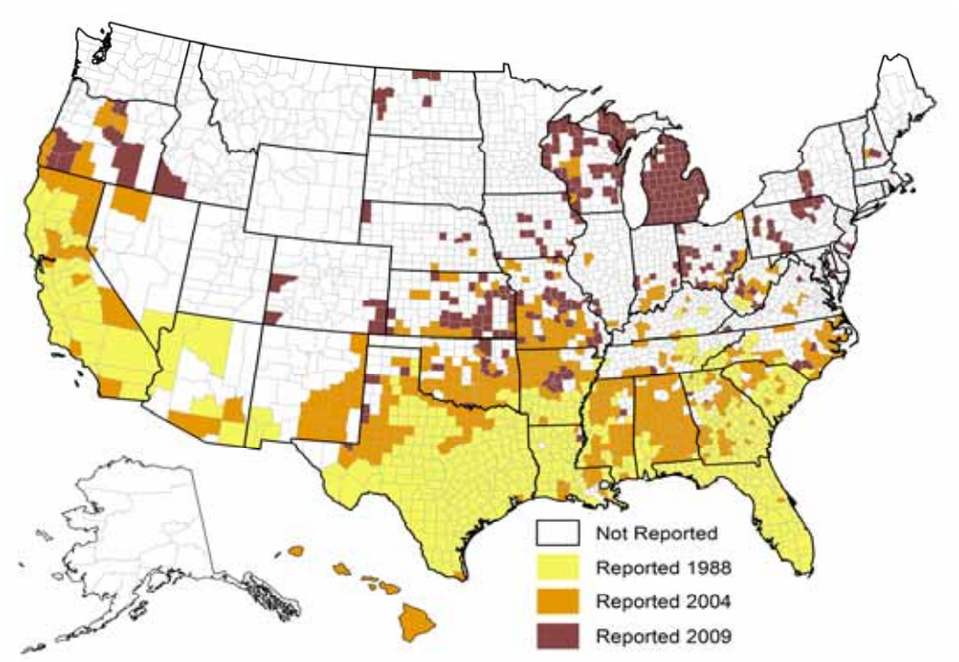
Biologists take serum samples from a feral hog in Texas.
Courtesy APHIS

To succeed, the program will require a sustained multidimensional effort .

fort to prevent feral swine from escaping farms and game ranches and to report promptly any new feral swine activity. At the strategic level, federal and state officials have called for the establishment of a coordinated, comprehensive feral swine control program [30, 35]. To succeed, such a program would likely require legislation and regulatory changes, coupled with a sustained multidimensional effort involving public education, law enforcement, and feral swine population suppression. Current efforts to control feral swine, which differ widely among states, are fragmented and only marginally effective [35].

History has shown that once bovine TB becomes established in a wildlife population, it is very difficult to eradicate the disease. TB-infected feral swine populations can rapidly become a burden to livestock animal production. The emergence of feral swine as a reservoir species for bovine TB in the Mediterranean region should serve as cautionary tale for North America, where feral swine and cattle populations occur at much higher densities. If bovine TB were to become established in the feral swine populations of North America, the impacts to the livestock and wildlife recreation industries would likely far exceed those in the Mediterranean.

Figure 1. Feral Swine Range Distribution Map



Sources: Sources include data from APHIS Wildlife Services National Wildlife Disease and Emergency Response Program, the Southeastern Cooperative Wildlife Disease Study; and State agency press releases.

References:

http://www.doh.state.fl.us/Environment/medicine/One_Health/BovineTB_references.pdf

Ryan Miller-I am an ecologist and senior analyst with APHIS Veterinary Services, Centers for Epidemiology and Animal Health in Fort Collins, Colorado. As part of the Spatial Epidemiology Team I provide leadership and expertise in wildlife ecology, wildlife / livestock interactions and disease ecology."

Steven J. Sweeney, MS, DVM-Currently I am a wildlife health specialist and senior analyst with APHIS Veterinary Services, Centers for Epidemiology and Animal Health (CEAH) in Fort Collins, CO. Here I provide leadership and expertise in wildlife/livestock diseases, climate change, and veterinary medicine as a member of

CEAH's Global Intelligence and Forecasting Team.

Health events can rapidly become global public health concerns as seen during the recent SARS, avian and swine influenza outbreaks.

There is a need for a multidisciplinary approach to monitoring and reporting zoonotic disease outbreaks.

Zoonoses Integration Project (ZIP) is a component of a disease surveillance fusion cell that assimilates public health studies and reports as well as general media sources.

A Novel Approach to Zoonotic Population Health Monitoring: The Zoonoses Integration Project

Tom Doker, DVM, DACVPM, MPH, CPH and Cornelia Redding, MPH, MA

Introduction

Zoonotic diseases comprise most of the pathogens that currently cause human disease and are potential bioterrorism and emerging infectious disease agents. Public health officials, medical practitioners, and wildlife biologists from various countries report outbreaks of significance to either the World Health Organization or to the World Organization for Animal Health of the United Nations. Zoonotic disease surveillance is complex because several animals can be involved in linking agents to cases of human disease. Animal reservoirs (domestic, companion, and wildlife species); vectors from across the animal kingdom; and different hosts (primary, intermediate, etc.) create a multifaceted epidemiology. All of these species vary in range and population due to environmental factors from weather and geological events, direct human interactions, and habitat modifications. In effect, zoonotic diseases reflect an epitome of the One Health concept.

The Zoonoses Integration Project (ZIP) is a component of a disease surveil- fusion cell that assimilates public health studies and reports as well as general media and other sources. Quantitative and qualitative data are gathered, analyzed, and amassed by subject matter experts (SME) in infectious disease, epidemiology, informatics, geographic information systems (GIS), environmental health, and veterinary medicine. The daily situational awareness (SA) report generated from these sources is tributed to various federal/state/local public health departments. The ZIP is part of a national biosurveillance strategy for providing timely, high-quality animal, human, and environmental health information for early detection, analysis, forecasting, and research.

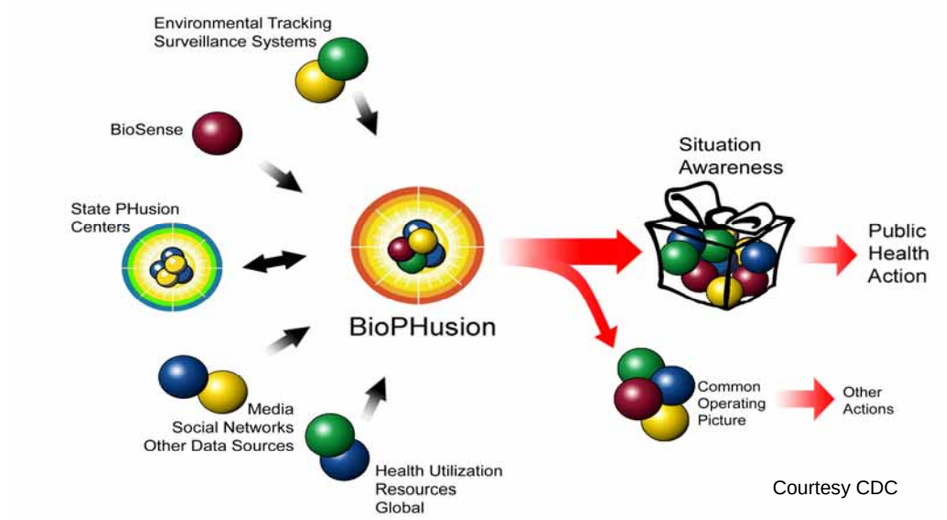
Benefits of Fusion Cell Analysis

There is a need for the development of a multidisciplinary (One Health) ap- to SA that incorporates a novel approach to monitoring and reporting zoonotic disease outbreaks. Many public health administrators and practitioners do not have the time or expertise to assimilate information to provide the SA they require on a daily basis. Moreover, health events in other countries can rapidly become global public health concerns as seen during recent outbreaks (SARS, avian and swine influenza, etc.). A fusion that provided real-time SA could ensure timely reporting of local and international public health threats. The element could monitor, analyze, and report critical outbreak information through generation of a concise daily report for international, national, district, and local SA. The figure shows the findings resulting from seminal work on such a system (ZIP) presented at the International Society of Disease Surveillance meeting last De- ber.

Many systems are available that collect, analyze, present, and distribute surveillance data on zoonotic diseases. However, they often focus on a single discipline (or within a localized area) or require extensive analysis by the user. For these and other reasons, many field practitioners (human, veterinary, and environmental) do not use biosurveillance to add ruleouts for that day's diagnostic challenges. The premise be- BioPHusion, of which the ZIP comprised one component, was to present a daily SA re-

port of the top disease risks to the United States. BioPHusion operated for two years within the National Center of Zoonotic, Vector-borne, and Enteric Diseases at the Centers of Disease Control and Prevention in Atlanta, Georgia. Although these SA reports remained secure, those on the distribution list could choose to share the information as appropriate. Ideally, these daily analyses would be available to assist field practitioners.

Dr. Tom Doker



Courtesy CDC

Pictures from the veterinary public health mission in Iraq ……

……trying to reestablish biosurveillance in 2007-2008.

Description of the ZIP Computer Application

The ZIP was interfaced directly with the BioPHusion database in order to obtain direct feeds from various public health sources and to allow for reverse exchange of zoonotic analyses. Exclusive fields were available for zoonotic disease, pathogen, species, and geographic data. Two levels of information were generated. Initially, the data analyzed each day were input into Tier 1 records for further discussion at the daily 1:00 p.m. Tier 2 meetings. During these meetings, the various SMEs decided which data merited distribution within the SA report. At times, additional research, analysis, or interagency communication was necessary for determination of the reliability, validity, and significance of an event. Tier 2 records were generated for all data deemed important enough for circulation.

The zoonotic disease determined from open sources was often reported by the common name from that region. Thus, a list of synonyms was useful in helping analysts to choose the corresponding scientific name from the dropdown. Pathogen agents were linked to the selected disease to facilitate subtype entries, if provided by the source. Subtypes are important for recommending vaccines, predicting susceptibility and transmissibility, and tracking agent ecology.

Data could be classified by cited species into wildlife, domestic, companion, zoo, feral or unknown animal groups. All categories are relevant when considering the One Health concept. Not only do diseases spread between persons and between a human and an animal, transmission of disease occurs between other animal species as well. The burden and range of diseases within vector, reservoir, and host species determines spillover occurrences in Homo sapiens and thus warrant surveillance. In addition, environmental events ranging from natural disasters to daily human interactions (farming, hunting, foresting, etc.) influence the emergence of zoonoses from these different species. Thus defining diseases geographically was an essential component of the ZIP computer application.

Cornelia Redding

The ZIP represents a multidisciplinary approach to SA that incorporates a novel approach to monitoring and reporting zoonotic disease outbreaks.

Thomas Doker

Conclusion

The ZIP represents a multidisciplinary approach to SA that incorporates a novel approach to monitoring and reporting zoonotic disease outbreaks. Some excellent biosurveillance systems currently in use present data to all stakeholders at once (e.g., ProMed, HealthMap). Although policy and decision makers at all levels can view the same information, extensive analysis can be required to determine personal SA needs. Other available surveillance systems involve single disciplines/diseases or localized disease events without incorporating input more representative of global One Health concepts.

Limitations for the ZIP include funding and possible restriction of relevant data. Who should pay for a service that would need to employ the numerous analysts and SMEs required to keep a fusion cell operational? Would the dots be connected in time by a single unit to ensure timely SA of outbreak information to the professionals with "boots on the ground" for public health action?

Dr. Tom Doker is the Public Health Flight Commander at Sheppard Air Force Base, Wichita Falls, TX

Cornelia Redding, working as a Public Health Analyst for the National Center for Infectious Diseases at the Centers for Disease Control and Prevention, provided public health information from traditional and non-traditional sources (e.g. social networking blogs, ecological data, animal surveillance, weather, media reports, press, state and local health departments, external federal stakeholders, public health listservs, internet postings, websites, etc.) for incorporation into the Bio-Phusion data base.

Wildlife health is "One Health" and more

Thierry Work, DVM

"Recognizing that human and animal health and mental health (via the human-animal bond phenomenon) are inextricably linked, One Health seeks to promote, improve, and defend the health and well-being of all species by enhancing cooperation and collaboration between physicians, veterinarians, and other scientific health professionals and by promoting strengths in leadership and management to achieve these goals." Thus reads the One Health mission statement.

When asked to write a segment on the relationship between One Health and wildlife disease, I ruminated hard on reconciling this mission statement with the question: What is the relationship between wildlife health and One Health? I reckon quite a bit. In fact, the One Health mission statement would be subsumed by the mission statement of the Wildlife Disease Association (WDA), an organization that's been around since 1952 and whose mission is to "...acquire, disseminate, and apply knowledge of the health and diseases of wild animals in relation to their biology, conservation, and interactions with human and domestic animals." (disclosure-I'm a member).

The WDA promotes a field of study that incorporates such disparate disciplines as medicine, ecology, microbiology, entomology, public health, and wildlife management just to name a few. More importantly, the organization provides a venue where wildlife health professionals and wildlife biologists can share ideas and information on topics

The study of wildlife health is an excellent way to gauge the health of an ecosystem.

ranging from epidemic tumors in the Tasmanian devil, chronic wasting disease of deer, West Nile virus in wild birds, chytrid fungi in endangered amphibians and coral reef health.

The study of wildlife health is a good way to gauge the health of an ecosystem by actually looking at the health of organisms that comprise that ecosystem. Because wildlife health issues are invariably complex, ranging from the landscape to submicron scale, progress in this arena can only be made if wildlife health professionals and biologists work closely together. This practice by many dedicated professionals over the years has led to significant strides in our understanding of many wildlife diseases to the point where some, such as avian botulism, rabies, and avian cholera, can be quite effectively managed on a landscape (rabies) or local scale (botulism, cholera).

The Wildlife Disease Association's work incorporates such disparate disciplines as medicine, ecology, microbiology, entomology, public health, and wildlife management just to name a few.

Some man-made wildlife health issues such as diclofenac poisoning of vultures in India or lead poisoning of waterfowl in the USA from the ingestion of lead shot have had national ramifications leading to national policy shifts in the case of lead poisoning (e.g. banning of lead shot for waterfowl hunting in the USA). That said, many pressing problems remain to be solved, particularly for potentially zoonotic wildlife diseases or diseases that affect endangered species where every loss of an individual is comparatively grave. And while great strides have been made in our understanding of wildlife diseases in terrestrial ecosystems, our understanding of wildlife health in aquatic and marine ecosystems is more paltry.

Given that about 50% of the world's population lives near the coasts and that the ocean provides a significant source of protein to humanity, it would seem timely to treat this region with more deference and to begin understanding the health of organisms in those ecosystems. We have a good base of information on the health of charismatic marine megafauna such as marine mammals and seabirds, but considering that the majority of the biomass of marine life is invertebrates or fish, it seems they should get comparatively more attention. Given how much remains to be learned, and given how global communications between scientists is being facilitated by the world wide web, this is an exciting time to be in the wildlife health profession. Understanding major causes of morbidity and mortality in wildlife in terrestrial and marine ecosystems at multiple trophic levels with an eye to mitigating or preventing them for the ultimate benefit of humanity; that sounds like One Health.

That sounds like One Health!

Dr. Thierry Work is a Wildlife Disease Specialist from the U.S. Geological Survey's National Wildlife Health Center at Honolulu Field Station.

ONE HEALTH: PEOPLE AND WILDLIFE SHARE THE NEED FOR A CLEAN ENVIRONMENT

A. Fairbrother, DVM, PhD

When I was in school studying wildlife management and veterinary medicine, the wildlife health profession was just beginning to take shape. The study of wildlife diseases had been a recognized profession for many years, but the application of that knowledge to the management of diseases in free ranging wildlife populations was not yet developed. In the several decades since, we have learned how to treat individual marine birds

and mammals to help them recover from oil spills, developed herd vaccination methods such as for brucellosis in bison, and implemented vector control programs to reduce disease transmission of mosquito-borne viruses such as West Nile. Wildlife health professionals and the general public also have come to understand that, as available habitat is reduced in size, we have an obligation to keep it free of pollution that might affect wildlife health.

With the exponential increase in chemical use over the last century, appropriate product stewardship and regulatory oversight has become necessary to ensure responsible chemical use.

As a professional ecological risk assessor, I help to maintain the health of human and wildlife populations through reducing and managing environmental pollution. There are many sites throughout the world that are contaminated due to the our past ignorance and business malpractice. With the exponential increase in chemical use over the last century, appropriate product stewardship and regulatory oversight has become necessary to ensure responsible chemical use. Ecotoxicologists and environmental health professionals play a vital role in identifying and cleaning up sites with soil or water contamination that are above risk levels. In doing so, we must make sure that cleanup programs are appropriately designed so as to not unnecessarily remove or harm clean habitat that provide refugia from which species can recolonize. We also provide expert advice to ensure that new products, pesticides, and chemicals are used wisely and without unintended consequences to the environment, fish, and wildlife.

As humans and wildlife share the same environments, their wellbeing are inextricably linked in environmental cleanup and chemical stewardship.

Because people share many of the same environments as wildlife and also depend upon clean air, soil, and water, human and wildlife well being are inextricably linked in environmental cleanup and chemical stewardship. In some cases, wildlife act as an early warning indicator for potential human health effects, particularly when they are more sensitive to a chemical (such as the canary in the mine, since small birds are more sensitive to carbon monoxide poisoning than are people) or have a shorter latency period (dogs, for example, will develop asbestosis in about 10 years whereas in people the disease requires 20 – 30 years to manifest). However, for other chemicals, human protection requires lower environmental contamination levels than for wildlife protection, as is the case for lead, mercury, or dixoins. Furthermore, people and wildlife often share the same food chain and therefore are similarly exposed to environmental contaminants. Clean soils are needed for growing crops and these same agricultural areas are used by small mammals nesting and foraging around field edges or songbirds feeding on aerial insects. Sediments frequently become contaminated with persistent pollutants as they are the final sink for contaminants in soils and water. Clean drinking water is a necessity for people and the same source is home to fish and the invertebrates they depend upon for food. Both people and many wildlife species eat fish from rivers, lakes, and the sea and so share a common need for clean water that can maintain fish stocks and ensure that the fish are not concentrating water-borne pollutants.

Even as we move toward eliminating known persistent and toxic pollutants such as PCBs, organochlorine pesticides, and leaded gasoline, we are discovering new risks from previously unknown sources. Most notably, recent advances in analytical chemistry methods have enabled the measurement of previously undetectable low levels of pharmaceuticals and personal care products in wastewater discharges. These include estrogens from the use of human birth control products that have been shown to feminize fish downstream from the water treatment plants. Caffeine, Prozac, cocaine, and other drugs are also measured and have been shown in laboratory studies to affect fish and amphibian behaviors. The obvious imperative is to learn more about the unintended consequences of our lifestyles on fish and wildlife as well as to ensure a clean drinking water supply for people. Other newly emerging chemical classes that have less obvious potential risks include the use of nanomaterials (very small, submicroscopic particles) in

clothing, cosmetics, paints, electronics, and medical delivery systems. Although our knowledge base about the potential toxicity of these materials is increasing, there are large challenges in studying their effects under realistic exposure scenarios. The increasingly larger volume of e-waste generated from disposal and re-use of electronics (especially personal computers) is another area of emerging environmental concern. Through the United Nations, many of the developing countries are looking for ways to develop the knowledge and international cooperation for managing these emerging contaminants before they become widespread pollutants.

People value a clean environment and the fish and wildlife it supports irrespective of their own health risks.

It is obvious, then, that full and appropriate protection of humans and the environment from chemical contamination embodies the concepts of One Health. The cycling of chemicals through different environmental media (air, soil, and water), the shared food chains, and the similarity in physiology and responses of humans and many wildlife species create an obvious scientific and management interrelationship. However, in the course of many environmental assessments in which I have been involved, it also has become apparent that people value a clean environment and the fish and wildlife it supports irrespective of their own health risks. This value takes many forms, including love of hunting and fishing, nature photography, and spiritual meaning. As a wildlife health professional, it is gratifying to see environmental managers and chemical regulators acknowledging more frequently the values people place on a clean environment not only for their own health protection but also for that of the fish, wildlife, and the other organisms that share our world.

The protection of humans, animals and the environment from chemical contamination embodies the concepts of One Health.

Dr. A. Fairbrother is a Senior Managing Scientist with Exponent and is an international expert in ecotoxicology, environmental cleanup, chemical regulation, and product stewardship. She is past-President of the American Association of Wildlife Veterinarians, Wildlife Disease Association, and Society of Environmental Toxicology and Chemistry and serves on many editorial boards and advisory committees. She previously worked as a research scientist at the US EPA where she studied effects of pesticides, pollutants, and endocrine disruptors on wildlife and wrote guidance and protocols for ecological risk assessments.

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Environmental Health News
Published by Environmental Health Sciences

Cancer in wildlife, normally rare, can signal toxic dangers

Crystal Gammon

Beluga whale

Wild animals normally are killed by cancer only in rare cases. But scientists have found that some deadly cancers in animals--including Quebec's belugas, California sea lions and North Sea flounder--seem to be triggered or accelerated by environmental contaminants. The tumors highlight the dangers that industrial activities pose – not just to animals, but to people in the same areas exposed to the same chemicals. But lack of research and environmental obstacles mean most cancers in wildlife remain undetected.

Research points to environmental pollutants as triggering or accelerating cancers in several wildlife populations around the world.

The cancers also highlight the dangers that industrial activities pose – not just to animals, but to people in the same areas, exposed to the same compounds.

Careful monitoring of wildlife populations can reveal cancer patterns that could send early warning signals to people

Thirty years ago, a Canadian marine biologist noticed something mysterious was happening to beluga whales in the St. Lawrence Estuary. Decades of over-hunting had decimated the population, but several years after the government put a stop to the practice, the belugas still hadn't recovered.

Two decades and hundreds of carcasses later, he had an answer. "They were dying of cancer," said Daniel Martineau, now a professor of pathology at the University of Montreal. The white whales were victims of intestinal cancers caused by industrial pollutants released into the St. Lawrence River by nearby aluminum smelters.

Now research points to environmental pollutants as the cause of deadly cancers in several wildlife populations around the world. Normally rare in most wildlife, cancers in California sea lions, North Sea flounder and Great Lakes catfish seem to have been triggered or accelerated by environmental contaminants. Other animal populations, including Tasmanian Devils, sea turtles, woodchucks, manatees, eels and sperm whales, also have been stricken with cancers, although they appear to stem from natural causes, including viruses, spontaneous tumors, or genetic factors.

In some cases, the survival of a species and the stability and biodiversity of an ecosystem is jeopardized. The cancers also highlight the dangers that industrial activities pose – not just to animals, but to people in the same areas, exposed to the same compounds. "We know that toxic compounds in the environment can cause cancer in humans, so it's not a far stretch to realize that pollutants can cause cancer in animals," says Denise McAloose, a pathologist with the Wildlife Conservation Society in New York, who recently reviewed the topic in the journal Nature Reviews Cancer.

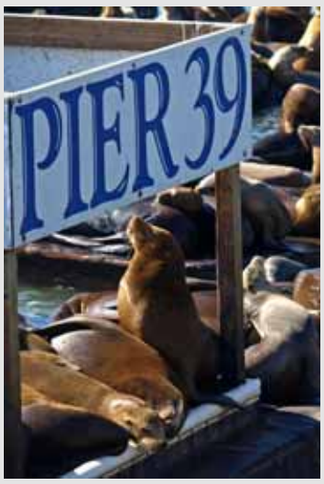
Animals have long been recognized as sentinels for human health hazards. Wildlife populations, such as the belugas, often interact with the same pollutants as people. In the St. Lawrence region of Quebec, people who worked in smelters near the cancer-stricken belugas have reported many cases of lung and bladder cancers linked to coal tar exposure at the factories. Other residents of the region have higher rates of digestive tract and breast cancers than people who live elsewhere in Quebec and Canada.

Scientists say careful monitoring of wildlife populations can reveal cancer patterns that could send early warning signals to people. While human cancers arising from pollutants can take decades to appear, wildlife diseases often show up earlier. Nevertheless, few resources have been dedicated to identifying wildlife cancers. Most cases go undetected. Obstacles such as high altitudes or deep waters make monitoring and collecting sick animals difficult, and carcasses are often decomposed or destroyed by scavengers before researchers can collect them.

"Cancer, overall, is very infrequent in animals," apparently less frequent than in humans, said Carol Meteyer, a wildlife pathologist with the National Wildlife Health Center in Madison, Wis. Meteyer said the shorter lifespan of birds and small mammals means fewer tumors than in people, although there is little data estimating the prevalence. In the past 34 years, the center has examined over 100,000 wild animals. Only 22 had tumors, and cancer killed only a handful of them—a death rate about 5,000 times lower than that of human beings.

Even when sick animals are identified, it can be difficult to link their cancers to environmental causes. Tying tumors to specific pollutants is "very challenging,"

Some persistent organic pollutants, such as PCBs, have been implicated in wildlife cancers.



PCB levels along the California coast will likely pose a threat to the sea lions for decades

Up to 90 percent of the PCBs in a mother sea lion's body can be transferred to her first pup.

Meteyer said, because of the small number of cases and the wide geographic range of many animals. Many tumors are spontaneous, arising from a "wild cell type that takes off on its own," she said. Most of the cancer cases she's seen in her 17 years at the center involved spontaneous tumors. "Only certain tumors can be indicators of environmental contamination and ecosystem health," McAloose said.

Despite the obstacles, identifying animals at risk of cancer is essential for protecting these populations and their human counterparts, she said. Some persistent organic pollutants are implicated in wildlife cancer clusters. These pollutants, including PCBs (polychlorinated biphenyls) and the pesticide DDT, build up in the environment and accumulate in the fatty tissues of wildlife.

Called POPs, these compounds contribute to cancers in a variety of ways. Often they interact directly with an animal's DNA by disrupting its structure and leading to mistakes in replication. These mistakes accumulate over the animal's lifetime, leading to tumors and, possibly, death. In other cases, the chemicals attach to DNA and turn genes on or off.

Pollutants can also contribute to cancers by distracting an animal's immune system, allowing certain types of viruses to cause tumors. Flounder from Germany's contaminated Elbe estuary had higher rates of liver cancer than fish from unpolluted regions, according to a study published last year. Researchers found a link between higher levels of heavy metals and POPs and increased liver lesions in the flounder.

Also, sea lions along California's Central Coast are dying from a cancer possibly associated with industrial pollutants. A 2005 study found elevated levels of polychlorinated biphenyls, or PCBs, in the blubber of adult sea lions with reproductive tract cancers. Those with cancer had PCB levels 85 percent higher than those without cancer. One weakness of the study, however, is that sick or dead marine mammals often have higher contaminant concentrations in their bodies because they have less fat.

The carcinomas in California sea lions are caused by a herpes virus. It's unclear how PCBs may contribute to the cancer, but researchers speculate they may suppress their immune systems, allowing the herpes virus to replicate unchecked. Previous research showed that PCBs in fish destroyed the immune cells of another marine mammal – harbour seals – and contributed to a European seal die-off from a distemper-like virus. Although the United States banned PCB production in 1979, PCBs are still found in electrical equipment, and they sometimes leak into the air or water.

PCB levels along the California coast will likely pose a threat to the sea lions for decades, wildlife experts say. "Mothers dump their contaminant loads to their first born pups," said Gina Ylitalo, a research chemist with the National Oceanic and Atmospheric Administration in Seattle, Washington, who led the study. Up to 90 percent of the PCBs in a mother's body can be transferred to her first pup, meaning that PCB loads decrease only slightly from generation to generation. High levels of PCBs are also passed to pups through milk.

While these cancers haven't impacted the overall number sea lions – the population has grown steadily by about six percent each year – they suggest that people might also be exposed to dangerous levels of pollutants from consuming the same fish. In California, state officials warn anglers against eating some fish caught in San Fran-

cisco Bay and in waters off the Los Angeles area because of the cancer risk posed by PCBs and DDT.

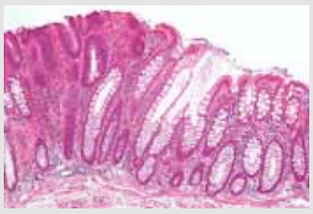
Mussels and barnacles in the intertidal pool
Courtesy Mark A. Wilson

Chemicals from the aluminum smelters along the waterway were absorbed by mussels and other invertebrates that are the main source of food for the beluga whales.

In Ohio's Black River in the 1980s, brown bullhead catfish were nearly wiped out by liver cancers caused by contaminants from a coking facility. The population rebounded within four years of the facility closing in 1983.

Belugas in the St. Lawrence Estuary have drawn the most attention because of the estuary's proximity to aluminum smelters. The smelters released 20 tons of polycyclic aromatic hydrocarbons into nearby waters every year. One of the substances, benzo(a)pyrene, which is classified as a probable human carcinogen, accounted for nearly a ton of the smelters' yearly emissions. The compounds accumulated in sediments and were absorbed by mussels and other invertebrates, which are the main food source of the one-ton whales. One study found that blue mussels transplanted into the estuary increased their benzo(a)pyrene levels 200-fold.

When Martineau and his group began analyzing beluga carcasses in the early 1980s, they noticed that many of the whales had intestinal tumors. Over the next 20 years, the group found cancer to be the major cause of death in adult belugas—a surprising finding given the rarity of the disease in wildlife. In particular, small-intestinal tumors seemed to be especially prevalent and deadly for the animals: 27 percent had died of cancer, and 30 percent of the cancers were found in their small intestines.



Micrograph of a tubular adenoma in the colorectal mucosa Courtesy Nephron

Intestinal cancer was found to be the major cause of death in the adult belugas.

Colon cancer is common in humans and other animals, but small-intestinal cancers are relatively rare. The 27 percent rate of cancer deaths for the estuary's belugas is similar to the 23 percent rate for humans in the Western world, Martineau noted. McAloose called that similarity "very interesting … Similar diseases caused by similar circumstances often have similar outcomes."

In 2004, two years after the beluga study was published, the aluminum smelters near the St. Lawrence estuary closed. But, five years later, the belugas that first caught Martineau's attention have not recovered. And he is not surprised. "Cancer is the consequence of a lifetime of accumulating mutations," said Martineau, who added that the deadly disease "is exactly what you would expect to find in animals that are eating from these sediments." The beluga population, he suspects, won't begin to recover for at least half a lifetime – 35 years, in the case of these long-lived whales. Fewer than 1,000 belugas, which are listed as a threatened species in Canada, remain in the estuary.

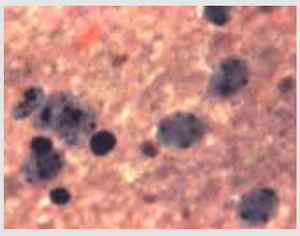
Researchers like Martineau and McAloose continue to stress the importance of studying wildlife diseases driven by pollution. Developmental disorders and reproductive problems in animals may also be linked to industrial pollutants and other contaminants. "Cancer may just be the easiest endpoint to get our hands on," McAloose said. "We need to continue try to see connections between pollutants and disease, but currently there just aren't a lot of people looking."

Crystal Gammon is a frequent contributor to Environmental Health News.

Courtesy Joe Schneid

My first case of equine rabies was impressive.

The mule's brain tested positive for rabies.



Impression slide depicts the cellular changes due to rabies encephalitis including intracellular Negri bodies
Courtesy CDC/G. Heid

I wonder why we have not done more worldwide control of the disease. With current technology, I really believe it could even be eradicated.

Mad Mules

Hank Stockton, DVM, DTVM

My first job after graduation (1947) was working with Dr. M.J. Luster (KCVC 1916). His practice was located on the golden buckle of the cotton belt, Clarksdale, Mississippi, in the Mississippi Delta. At that time, delta agriculture was mostly cotton farming done on large plantations. All delta economics orbited around cotton production and marketing.

This was the time before predominantly mechanized farm equipment. Almost all the Delta's farm traction was done by mules. It was not uncommon for larger plantations to have over 1,000 mules housed in strategically located mule barns over the plantation. These mules were cared for by a "hostler". Mule health services was on-going including hoof trimming, teeth floating, dealing with colics, swamp fever (equine infectious anemia), anthrax, tetanus, wire cuts and screw worm infestations, parasites, vaccinations and surgeries.

My first case of equine rabies was impressive. A large cotton planter had a hostler named "Hamp". He was an excellent mule handler with a scientifically bent inquisitive mind and very strong. When I responded to a call to see a sick mule, Hamp met me at the gate of a mule barn and holding lot of about three hundred head. At that time it was professionally trendy for veterinarians on-call to carry a small black leather bag. These bags contained thermometer, stethoscope, metal encased syringes, a scalpel set.

Hamp pointed that the sick mule was out behind the barn. I proceeded that direction but noted that Hamp hung back behind the gate. As I rounded the barn's corner, I met a screaming open-mouth charging mule. I fed my little black bag into his open mouth, which he tore up and scattered around the mule lot. I dove under the feed trough in the barn while he chased other mules or anything that moved.

When the mule diverted his attention to attacking other mules I slid out from under the feed trough and raced for the gate. After vaulting over the gate, I asked Hemp why he had not cautioned me about this mule attacking people.

He replied:"Young doctus, I wanted to see if that mule would attack a white boy like he do's a black man." The mule's brain tested positive for rabies.

In the past seventy odd years, I have seen hundreds of rabies cases in most species of animals including humans. Most have been in South America while working with vampire bats. Many have been the furious form, not the paralytic form. WHO reports

Dr. Hank Stoddard

thousands of human casualties annually due to rabies. It is a horrible death in all animals especially humans. I have nagging thoughts about the disease.

I wonder why we have not done more worldwide control of the disease. With current technology, I really believe it could even be eradicated.

Dr. Hank Stoddard is now semi-retired and currently specializes in consulting on fish and aquatic animals problems at the Shamrock Veterinary Clinic in in Cross City, Florida.

One Health in Action !

The Illinois Center for One Health holds a two day 'One Health Illinois Summit'

"One Health" for Illinois

John A. Herrmann, DVM, MPH, DACT and Edwin C. Hahn, PHD

In launching the Illinois Center for One Health, the University of Illinois College of Veterinary Medicine seeks to improve the health of the human, animal, and ecosystem communities of Illinois. The new Center is posited on the "one health" concept: that the health and well-being of these three realms—people, animals, and the environment—are inextricably interconnected, and that solutions to health issues must arise from this broad perspective. A cornerstone of the Center is the DVM-MPH program, fulfilling a need to cross-train science-minded students who will take on leadership of interdisciplinary approaches to intersecting health issues. Now in its fifth year, the program represents a joint collaboration between the College of Veterinary Medicine and the School of Public Health at the University of Illinois at Chicago.

The Illinois Center for One Health is a collaboration between the College of Veterinary Medicine and the School of Public Health at the University of Illinois at Chicago.

To set the agenda for this initiative, the Center convened more than 40 topical experts from academia, policymakers from state and federal government, and advocates from private sector and the food animal industry on February 24 and 25 for a "One Health Illinois Summit." The goal was to identify the most promising avenues by which the Center can advance health in Illinois.

Given the broad lens of the "one health" perspective, topics ranged widely as participants spent the first day of the Summit considering the current health status of Illinois communities. Included were reports on disparities in health along socioeconomic and rural/urban divides, the importance of species biodiversity in preventing emerging infectious diseases, and the impact of the health of agricultural workforce on food safety.

Day two of the Summit involved small-group discussion and consensus-building on how the Center can have an impact on Illinois health needs. The resulting action plan encompasses three areas of focus:

- Developing a surveillance system that integrates data on infectious and contagious human and animal diseases, chronic human illnesses, lifestyle choices, food safety, wildlife disease, and more
- Enhancing communication among researchers, government agencies, policymakers, and the private sector regarding issues, activities, and data related to community health and health policy
- Educating the public about "one health" concepts and initiatives

University of Illinois

The joint DVM-MPH program fulfills the need to cross-train science-minded students who will take on leadership of interdisciplinary approaches to intersecting health issues.

An additional benefit of the summit was that participants, including a number of leaders in setting health policy for Illinois, came away with new insights about the challenges and scope of health issues. Many expressed a willingness to continue working together to improve communication between different health agencies and disparate medical research groups that have grown apart with lost awareness of health commonalities.

"The One Medicine Summit showed me a new way of thinking about health issues, and I ' m sure I will find it helpful in the future as I work on health policy matters, " said David Carvalho, deputy director in the Office of Policy, Planning, and Statistics in the Illinois Department of Public Health.

The Center received funding of $235,000 in 2009 from the USDA National Institute for Food and Agriculture.

For more on the work of the Illinois Center for One Health, see http://vetmed.illinois.edu/onehealth/

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Special Thanks

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Contributors:

Continued.....

The One Health Newsletter is interested in publishing articles from a variety of view points and perspectives and any opinions and statements made in the Newsletter articles belong to the author (s), not the Editor, Editorial Board or Newsletter Contributors.

Coming Events:

59th Wildlife Disease Association (WDA) Annual Meeting

Puerto Iguazu, Argentina

May 30 –June 4, 2010

http://sites.google.com/site/wda2010argentina/conference-home-2

The 60th James Steele Conference On Diseases In Nature Transmissible To Man

Hyatt Regency Austin, Austin, Texas

June 9-11, 2010

http://sites.google.com/site/diseasesinnature/

American Veterinary Medical Association

2010 AVMA Annual Convention

Atlanta

July 31 – August 3, 2010

https://www.avmaconvention.org/avma10/public/enter.aspx

2010 American Physiological Society Intersociety Meeting

Global Change and Global Science:
Comparative Physiology in a Changing World

Westminster, Colorado, USA

August 4-7, 2010

http://www.the-aps.org/meetings/aps/comparative/index.htm.

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Coming Events:

9th European Wildlife Diseases Association Conference

"Healthy wildlife, healthy people"

On the Dutch island of Vlieland

September 13-16, 2010

http://www.ewda-2010.nl/default.aspx

One Health 2011 Congress Melbourne Convention Centre

Victoria, Australia

February 14-16, 2011

http://onehealth2011.com/

Recent One Health Publications:

- **Importance of collaboration on wildlife disease issues,** Integrative Zoology**,** Volume 4 Issue 4, p 323-324 Hongxuan HE, Dale L. NOLTE

  http://www3.interscience.wiley.com/cgi-bin/fulltext/123208339/PDFSTART

- **Symposium on the Ecology of Plague and Its Effects on Wildlife,** ***Special Issue,*** Vector-Borne and Zoonotic Disease Vol. 10, No.1, Guest Editors: Michael F. Antolin, Dean E. Biggins, Christopher J. Brand, Jack F. Cully, Laura E. Ellison, Kenneth L. Gage, and Tonie E. Rocke

  http://www.liebertonline.com/toc/vbz/10/1

- **SCWDS BRIEFS** - Quarterly Newsletter from the Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, The University of Georgia.

  http://www.uga.edu/scwds/briefs/January2010Briefs.pdf

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Recent One Health Publications:

- **Wildlife Disease News Digest,** Wildlife Disease News and Information by the NBII Wildlife Disease Information Node (WDIN)

"This news service focuses on wildlife diseases, and wildlife morbidity/mortality, especially as they relate to human and ecosystem health. We work to cover emerging infectious diseases, zoonoses, environmental toxins, population threats, unexplained incidents, die-offs and more."

http://wdin.blogspot.com/

- **Veterinary education for global animal and public health,** OIE, World Organization for Animal Health, Scientific and Technical Review 28 (2), 2009, D.A. Walsh

http://www.oie.int/boutique/index.php?page=ficprod&id_produit=740&lang=en

- **'MedMyst' – Medical Mysteries on the Web.** Produced by Rice University (USA) – Center for Technology and Learning

Medical Mysteries is an unique interactive, problem-based adventure game for children of all ages that engages them in the role of scientist, historian, and detective. There are three missions, each with its own Learning objectives. The knowledge gained from each mission will help the player understand how infectious diseases are spread.

http://medmyst.rice.edu/

For other One Health publications visit the One Health Initiative website.

http://www.onehealthinitiative.com/publications.php