WCS saves wildlife and wild places worldwide through science, conservation action, education, and inspiring people to value nature.

WCS envisions a world where wildlife thrives in healthy lands and seas, valued by societies that embrace and benefit from the diversity and integrity of life on earth.

WCS was the first conservation organization with a dedicated team of wildlife veterinarians and other health professionals deployed around the world.

Our Health Programs Report provides updates and insights on core health contributions to conservation. Together, we are securing a future for wildlife and wild places.
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PROGRAM HIGHLIGHTS

NEW YORK ZOOS AND AQUARIUM HIGHLIGHTS

- 550 animals housed at the Bronx Zoo’s Wildlife Health Center (including 150 confiscated reptiles)
- 13,700 samples from 3,200 animals analyzed in our medical laboratories
- 22,100 medical and pathology records written for 4,800 patients
- Anesthesia performed over 330 times for medical procedures on 210 animals

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>1600 bats sampled across the western United States to predict susceptibility to white-nose syndrome

Milestone of 1000 captive-reared Cayman blue iguanas released on Grand Cayman

>15,000 Afghan livestock vaccinated to reduce disease spillover to wild ungulates

Sampling and collaring of 30 kulan in the Gobi desert

21 loons sampled to assess coal-power plant impacts in the Northeastern United States

Over 1,200 wild gazelle sampled in a Foot and Mouth Disease outbreak in Mongolia

Deployment of a mobile test kit for Canine Distemper Virus in Russian tigers

Health examinations on 52 land iguanas in the Galapagos

Hand-rearing, release & monitoring of scarlet macaws in Guatemala

Examination & sampling of 267 vicunas in Peru & Bolivia for mange surveillance

228 birds sampled for avian influenza in Colombia

>350 Colombian amphibians sampled for chytrid and ranavirus

Health & genetic studies of white-footed tamarins in Colombia

Rehabilitation of rescued African grey parrots in Republic of Congo

Health support for 10,000 Radiated tortoises confiscated in Madagascar

Bat and great ape surveillance for Ebola virus in Republic of Congo

WCS HEALTH HIGHLIGHTS FROM THE FIELD
Canine Distemper Virus (CDV) is a long-standing problem for Amur tigers (*Panthera tigris altaica*) in Russia, that has also spilled over into Amur leopards (*Panthera pardus orientalis*). In 2018, we piloted deployment of the hand-held, field friendly CDV PCR testing system that we have developed. About the size of a brick, it uses temperature stable kits and reagents and a smartphone driven PCR thermocycler, with results obtained within one hour of sample collection. Training was conducted in Russia for WCS staff and collaborators at the Institute of Biology and Soil Sciences laboratory, with successful validation of the test on a known positive Amur leopard sample, followed by testing unknown samples under different scenarios. A trained team then went to the Ussyrisk Reserve to test samples in the field. Most were negative, but there were some positive brain and hair samples. A machine and test kits were left with field staff for ongoing sampling.

This year, we also deployed this same system to confirm CDV outbreaks in small carnivores in Austria and in raccoons (*Procyon lotor*) that presented with neurological signs in Central Park. We were thus able to demonstrate its utility for field diagnosis of CDV in natural outbreaks. The successful deployment of the CDV test kit will allow for continued testing in the field by WCS staff and our conservation colleagues to enable rapid detection of CDV in wildlife in the Russian Far East.
Detecting Endangered Species in Trade and in the Wild Using Mobile DNA Technology

The high value of shark fin used in traditional Chinese soup as well as demand for additional products (e.g. shark liver oil, skin, cartilage) are a major driver of shark fishing. Sharks suffer from unsustainable harvesting because of the ease of fraudulent labeling and lack of feasible methods to monitor the species involved.

Sustainable trade requires a traceability system that includes rapid species identification of fin and other shark products. We are currently piloting novel shark DNA test kits for use at export warehouses in Indonesia and Singapore, the world’s leading exporters of shark fins. We aim to enhance the capacity to improve wildlife trade monitoring and traceability to implement the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Organisms shed cells containing DNA into the environment (eDNA), that can be detected by extremely sensitive testing. Our Molecular team developed a portable, hand held, smartphone based, PCR kit for detection of eDNA (eDNA DETECTool) from the nearly extinct Yangtze giant softshell turtle (Rafetus swinhoei). In 2018, a pilot field study was conducted to validate the kit by testing water samples from lakes known to contain the only two of this species in Vietnam. The kit and sampling methods performed well, but no positives were detected, likely due to extremely warm water and ambient air temperatures causing microbiota overgrowth and rapid eDNA degradation. The deployment identified the technical modifications needed to optimize test methodologies and allowed training of a Vietnamese team to independently repeat the eDNA surveys to see if detection can be enhanced.
Understudied bat species and populations in western North America are facing the arrival of white-nose syndrome (WNS). WNS is a fungal disease affecting hibernating bats that was first identified in 2006 in New York and has since killed millions of bats in eastern North America. Since 2016, we have been part of a team collecting baseline empirical data on pre-WNS bat hibernation physiology, behavior, and morphology that can inform our understanding of western bat WNS risk factors, with the overall objective of developing the science to help identify species that are susceptible to WNS and thereby species of conservation concern and priorities for possible mitigations. Progress continued in 2018, with >1600 western bats sampled across multiple western states. Individual bat data is paired with measurements of hibernacula microclimates and telemetry tags are attached to individuals at the different study locations with receivers placed throughout the respective hibernacula. Species sampled include: Little brown bat (*Myotis lucifugus*), Western small-footed bat (*M. ciliolabrum*), Long-legged myotis (*M. volans*), Long-eared myotis (*M. evotis*), Townsend’s big-eared bat (*Corynorhinus townsendii*), Big brown bat (*Eptesicus fuscus*), and Tricolored bat (*Perimyotis subflavus*).
Since 2013, WCS has been collaring kulan (*Equus hemionus*) in the southern Gobi region of Mongolia to assess the potential impacts of mining related infrastructure development and other anthropogenic developments. Kulan are masters in coping with the unpredictability of their arid home, ranging over vast areas (about 10x the area of Delaware) every year in order to find sufficient browse and water.

In 2018, 30 kulan were anesthetized and sampled in the Southern Gobi, with satellite and camera collars placed on some animals. Camera collars will provide a multitude of novel insights into kulan physiology, habitat use and ecology. This year’s expedition was expanded to include two new capture locations to better understand the boundaries of the range of kulan. Blood chemistry allows assessment of the overall health status of the animal while white blood cell values reflect the individual’s overall ability to cope with stress. Additional samples were collected for next-generation sequencing to code parts of the equid genome to investigate species-specific and regional adaptations to life in extreme environments.
The last corridor for the scarlet macaw (*Ara macao*) in Latin America crosses Guatemala, Belize and Mexico. Environmental organizations estimate there are fewer than 1,000 scarlet macaws remaining in this corridor. The species is threatened by loss of habitat, caused by forest fires, the expansion of farming and new human settlements, and by wildlife traffickers who target its young. In addition, scarlet macaw nests have been occupied and attacked by Africanized bees. These are extremely aggressive hybrid insects resulting from the cross-breeding of local bees and African bees introduced in the past, that can kill parent birds or cause them to abandon the nest leading to the tragic consequence of the death of fledglings from starvation. Scarlet macaws are a priority for the WCS Guatemala program and our health team are assisting with hand-rearing fledglings and studying the health of the birds and their nests in the wild. The fledglings have been rescued from nests taken over by Africanized bees. In 2018, 33 scarlet macaws were sampled for health analysis and satellite collars were placed on released birds for tracking. The team monitored the position of tagged chicks every day, with the final signal of the year received from Mexico.
This year, we were honored to join Ecuadorian partners on three islands of the Galápagos archipelago to perform health evaluations on 52 iguanas of two species [Galápagos land iguanas (Conolophus subcristatus) and Santa Fe land iguanas (Conolophus pallidus)] on three islands. The health evaluations will form the basis of defining and describing the normal baseline health parameters for these two Galápagos land iguana species and results can be utilized for improved care of captive land iguanas at the Galápagos National Park and Charles Darwin Foundation. WCS’s Zoological Health Program staff have performed similar studies of other land iguana species, including the Grand Cayman or blue iguana (Cyclura lewisi); the Anegada ground or stout iguana (Cyclura pinguis); the Turks and Caicos rock iguana (Cyclura carinata); and the Allen Cays rock iguana (Cyclura cyclura inornata). All of these efforts have augmented existing conservation programs for these species.

Evaluation of the baseline health status of wildlife is important for conservation projects: This information serves to determine health parameters of the species of concern, is of value in caring for captive individuals of these species, and serves as a future reference point for comparison in the event of disease or death in captive or wild populations.
The Burmese roofed terrapin (*Batagur trivittata*) is critically endangered and is regarded as one of the world’s Top 25 most endangered turtles. As part of a comprehensive plan to save the species, WCS and the Turtle Survival Alliance (TSA) initiated ex- and in-situ conservation programs. The population is now approximately 900, with releases of head-started turtles to augment the wild population underway. As part of this species recovery program, our health team helps to assure released turtles are healthy, fit for survival in the wild, and do not pose a risk to wild turtle populations. In 2018, they conducted health assessments (physical examinations and biological sample collection) from 50 terrapins.

Our wildlife health team in Colombia is undertaking a project to evaluate the genetics and health of the white-footed tamarin (*Saguinus leucopus*) under in situ conditions in Anorí, an area affected by a hydroelectric project. The goal is to collect individual tamarin health data over time including: hematological values, blood chemistry, hemoparasites and gastrointestinal parasites and to standardize diagnostic tests for herpesvirus and arenavirus. Testing so far has identified hemoparasites (microfilarias) and gastrointestinal parasites (*Strongylus sp.* and *Prosthenorchis sp.*). Samples were also submitted for the detection of mercury.
Milestone for the Cayman Blue Iguana

The Cayman blue iguana (*Cyclura lewisi*) is found only on the island of Grand Cayman. Once numbering in the thousands, the species had declined to ~150-200 by the mid-1990’s, and by 2002 had plummeted to less than 20 wild iguanas. Since 2001, WCS’s Zoological Health Program (ZHP) has provided veterinary support for a captive breeding program in conjunction with the International Union for the Conservation of Nature (IUCN) Iguana Specialist Group. Activities include pre-release evaluations, health assessments, and annual examinations of Grand Cayman iguanas both at the breeding facility and free-ranging. Due to the success of the captive breeding program, iguanas have been released at the Queen Elizabeth II Botanic Park (QEII), the Salina Reserve, and the Colliers Wilderness Reserve. The amazing milestone of the 1,000th iguana released was achieved this summer! The entire wild population now consists of iguanas captive bred, reared, and/or head-started before release, and their offspring. Accomplishments of the ZHP component include determining baseline hematologic and biochemical parameters, enteric culture, parasite screening and treatments, and medical care and necropsies as necessary.

In recent years dogs killed many wild adults in the QEII, and a disease outbreak occurred in captive and wild adults that resulted in deaths and some animals successfully treated. Releases were postponed until the disease, and its impact on the wild population, was better understood. Studies are ongoing to determine the cause and source of the infection to enable better management of this disease. In 2018, our ZHP team examined 115 iguanas and, with all in good to excellent physical condition, releases resumed with pre-release quarantine procedures in place. A fence is being constructed around the park to prevent dogs from entering. Although events of the last few years delayed the planned discontinuation of the breeding program, the species population recovery goal has been achieved.
Central Africa is experiencing its third human Ebola outbreak in the past two years. Though outbreaks have occurred in the Democratic Republic of Congo, the whole region is endemic Ebola territory and country borders are porous. Ebola is a conservation priority as populations of great apes have been hard hit by the disease. The source of several human Ebola epidemics has been infected wildlife – gorillas, chimpanzees, small antelopes and wild pigs – some of which are an important part of the native population’s diet. Animals found dead are often collected for consumption: native hunter populations are at inherent risk of being exposed to Ebola virus. WCS’s Republic of Congo (RoC) wildlife health team has a long-running Ebola program that includes surveillance in wildlife carcasses and an educational outreach program directed at local hunter populations. Detecting an epidemic in wildlife can prevent greater spread of disease and form an Ebola early warning system, benefitting both human and wildlife health.

Our National Institutes of Health (NIH)-WCS collaboration studies the role of multiple animal species in maintenance of Ebola virus in wildlife and the factors which increase likelihood of Ebola virus spillover into human populations. In 2018, over 200 bats were sampled in RoC. Fruit bats, such as the hammer-headed fruit bat (*Hypsipops monstrosus*), may act as reservoirs of Ebola and the team piloted a solar-powered tracking unit that collects movement data from these bats in northern RoC, a region that has experienced multiple Ebola virus outbreaks over the last decade. This data, combined with virological test results provided by NIH, will be critical to understanding the ecology of the species and its role in the spillover of Ebola virus into great ape and human populations.
In the Andes of Bolivia and Peru, the wild camelid vicuña (*Vicuña vicuña*) is managed by local communities for their fiber. Several communities participate in programs supported by WCS that encourage the conservation and sustainable use of vicuña. In recent years, incidents of mange, caused by the *Sarcoptes scabei* mite, have been increasingly reported and the parasitic infection threatens the wild vicuña populations as well as the livelihoods of those that depend on vicuña fiber across the Andean region. Our teams initiated a new project to collect and analyze regional data on the prevalence of mange in vicuña and are further focused on strengthening the capacity of local people in the proper management of native pastures. This includes avoidance of overgrazing, and improving the use of water, as, due to climate change and loss of glaciers, this resource is increasingly scarce. Our health team also makes recommendations to communities to improve best practices during shearing activities to reduce the risk of stress in the vicuñas and decrease transmission of mange.
Peste des Petits Ruminants (PPR) is a highly contagious disease caused by a small ruminant morbillivirus that is closely related to, among others, rinderpest morbillivirus, measles morbillivirus and canine morbillivirus (also known as canine distemper virus). Following the successful global eradication of rinderpest in 2011, global consensus was reached on the need to eradicate PPR: The PPR Global Control and Eradication Strategy was endorsed in 2015. This global action was driven by the fact that PPR directly undermines food security and the livelihoods of some 300 million poor rural families that rely on some 2.1 billion small ruminants as their primary livestock resource. The global economic loss due to PPR is estimated at more than 2 billion US$ per year. Initial deliberations and reflections completely neglected wildlife and biodiversity conservation, despite evidence of severe implications of PPR; during the past two years the WCS health team has unequivocally documented the massive impact that PPR has had on Central Asian wild ungulates, killing, amongst other species, an estimated 75% of the Mongolian saiga population. We attended the inaugural meeting of the PPR Global Research and Expertise Network (PPR GREN) in Vienna in April 2018 and successfully leveraged WCS’s extensive expertise on PPR and wildlife to result in wildlife and biodiversity conservation being mainstreamed in the global eradication campaign.
Afghanistan PPR Vaccination Campaign

In 2018, paravets supervised by the WCS team vaccinated almost 15,000 sheep and goats (shoats) against PPR in the Wakhan National Park, where livestock is likely to come into close contact with urial sheep (Ovis aries vignei), a species considered vulnerable by the International Union for the Conservation of Nature (IUCN). Over 3,000 shoats in Big Pamir, at the fringe of habitats used by Marco Polo sheep (Ovis ammon polii), and almost 5,000 shoats in the Hindu Kush Mountain Range, in areas of potential contact with Siberian ibex (Capra sibirica) and urial, were also vaccinated against PPR. Local communities were extremely supportive of these vaccination campaigns, regarded as tangible benefits from WCS conservation work in the area.

Spillover Responses in Mongolia

Spread of the deadly PPR virus from sheep and goats to Mongolian saiga (Saiga tartarica mongolica) resulted in the loss of >75% of the population of this rare species. A SNAPP (Science for Nature and People Partnership) Steppe Health working group was thus formed with WCS presenting findings on most likely origin and course of the outbreak and the impact on saiga and other wild ungulates.

In 2018, WCS also supported local government staff in response to a disease epidemic in wild ungulates across the Gobi Desert region. Foot and Mouth Disease Virus (FMDV) had been confirmed in local cattle and then deaths of Mongolian gazelle (Procapra gutturosa), Goitered gazelle (Gazella subgutturosa) and Argali sheep (Ovis ammon) were reported. The WCS team collected samples from over 1,200 gazelle; over 1,000 animals were positive for FMDV. These spillovers highlight how vital good management and preventative veterinary care for domesticated livestock is to minimize risk of disease transfer to vulnerable wild ungulate populations.
In 2018, the United States Fish and Wildlife Services confiscated eight non-native turtles of three species [Indian roofed turtle (*Pangshura tecta*), Indian black turtle (*Melanachelys trijuga*), and Asian black breasted leaf turtles (*Geoemyda spengleri*)] and 93 ornate spiny-tailed lizards (*Uromastyx ornata*). The reptiles were presented to the Bronx Zoo’s Wildlife Health Center for triage, supportive care, and housing while legal cases progressed. The lizards arrived in variable states of health and two thirds of the lizards died despite intensive medical care. These lizards require very high environmental temperatures and the illnesses and deaths are likely a consequence of the inadequate care they suffered before arrival and resulting immunosuppression that predisposes them to bacterial infections and exacerbation of parasite infections.

The New York State Department of Environmental Conservation made unrelated confiscations of native turtles that included hundreds of turtles of multiple species. WCS received individuals including wood (*Glyptemys insculpta*), bog (*Glyptemys muhlenbergii*), and painted turtles (*Chrysemys picta*). The turtles were quarantined at the Wildlife Health Center.

Such cases demonstrate the role WCS plays in enforcement of wildlife laws and regulations, the close relationship we have with regulatory agencies, and the high standard of care we can provide at little notice when called upon to assist with animal care.
The Radiated Tortoise (*Astrochelys radiata*) is one of four species of Testudinidae endemic to Madagascar. They are characteristically recognized by their intricate radiating star carapacial patterns but this feature makes them particularly vulnerable to wildlife poaching for human consumption, traditional medicine, and the illegal pet trade. Despite legal protection and extensive multi-modal conservation efforts they remain listed as critically endangered by the International Union for the Conservation of Nature (IUCN). On April 10, 2018 approximately 10,000 radiated tortoises were confiscated from a private residence in Madagascar and three individuals arrested. The Turtle Survival Alliance (TSA) immediately dispatched Malagasy veterinarians and put out a call for assistance to the international turtle conservation community. A team of 10 staff from the Bronx Zoo left for Madagascar with little notice, each carrying approximately 100 lbs. of medical supplies. Almost 4,000 of the over 10,000 radiated tortoises confiscated required medical care, provided by the consortium of responding institutions. Although about 10% of the tortoises confiscated died, most of these were in the first 10 days after confiscation. Necropsy examinations were largely performed by WCS staff, and information gained enhanced the care provided to the living tortoises. Testing in New York of samples collected will inform decisions about the ultimate disposition of these tortoises.

WCS is a major supporter of TSA, on an individual and an institutional basis, and as a source of volunteers, equipment and services.
Coal-fired power plants in the Midwest and Northeast produce mercury and acidic emissions that pollute the environment. This smoke contains toxins that rain down on the Northeast as acid rain containing mercury, which is then deposited in the lakes. Common loons (Gavia immer) are long-lived predators at the top of the aquatic food chain that nest, feed, and raise their young on these lakes, and therefore serve as excellent sentinels for mercury surveillance. From zooplankton the mercury moves from the water up the loon’s food chain, including crayfish, amphibians, and fish. Loons return to the Adirondacks yearly, which facilitates long-term, individual longitudinal studies and an understanding of mercury’s health effects. Since 2003, the Zoological Health Program has provided veterinary support for an annual common loon research program in the Adirondacks and in 2018 the team examined and sampled 21 loons. Census results revealed a relatively stable population estimated at approximately 2000 loons in the Adirondacks.
Diabetes in a Gorilla

Diabetes is a familiar human medical condition typically treated with diet, exercise, blood monitoring, and insulin injections. Since all mammals have a pancreas that produces insulin to regulate their sugar levels, they can also develop diabetes. However, it manifests differently in each species, making diagnosis harder. It is even more challenging to treat diabetes in our patients because each species responds to treatment differently.

“N’tondo,” a 25 year old silverback Western lowland gorilla (Gorilla gorilla gorilla) was diagnosed with diabetes after losing weight, despite a good appetite. Gorillas are particularly difficult to collect awake blood samples from but luckily he is a very good patient, and keepers trained him for blood collection from his toe so we could monitor his response to treatment without needing to anesthetize him for samples. His disease did not initially respond, and we discovered that one of his Irritable Bowel Disease medications was causing his diabetes. Ironically, this is often the medication chosen for people with both IBD and diabetes because it does not affect blood glucose in people. Changing N’tondo’s IBD medication completely resolved his diabetes.

Investigating Cardiac Disease in Gelada

WCS is one of only two U.S. zoos that display gelada (Theropithecus gelada). WCS pathologists worryingly discovered a high incidence of cardiac disease in deceased gelada, mostly affecting male middle-aged gelada, who died abruptly with no warning signs prior to death. Colleagues at European zoos also reported cardiac disease as common in their gelada. We suspect that the animals develop fatal cardiac arrhythmias from which they die. To investigate, WCS veterinarians teamed up with cardiologists from Mount Sinai Hospital, placing advanced LINQ cardiac monitors on gelada which record ECGs and heart rates when abnormal cardiac rhythms and rates occur. The data is immediately transmitted by wireless technology to a monitor, and to cardiologists by cellular service. This is one of the first times LINQ monitors have been used in non-human primates. Our geladas are closely monitored daily, and veterinarians and cardiologists analyze data from the devices to help understand their cardiac function and to hopefully intervene medically if cardiac disease is detected. These advances in standards of care for our animals, which significantly benefit their health, are facilitated by the close relationships we have with the local biomedical community.
Our aquatic animal health team participated in field studies of great white sharks \((Carcharodon carcharias)\) in conjunction with our partner OCEARCH in Nova Scotia. During the expedition seven subadult and adult white sharks of both sexes were successfully tagged, sampled and released. Our aquatic health veterinarians are also key members of a team studying juvenile great white sharks at a shark nursery discovered right off the shores of Long Island, New York.

In the Fall of 2018, a mortality event involving free ranging smooth dogfish \((Mustelus canis)\) occurred along Coney Island and Brighton Beaches in Brooklyn, NY. Our necropsy investigations determined that the illnesses and deaths were due to a severe infection in the brain by a small ciliated protozoa \((scuticociliate)\). Most of these organisms are ubiquitous free-living inhabitants of estuaries and coastal zones. The phenomenon of scuticociliates causing mortality events in wild shark populations is remarkable in the context of aquatic pathogens among wild fish populations because seldom are such intense infections associated with strandings and species-specific fish kills, but our investigation establishes this pathogen as a health risk to both wild and captive shark populations.
Medical and surgical care of aquatic patients like sharks, fish, and marine invertebrates can be challenging. Our Aquatic Health team has pioneered many innovative advances at the New York Aquarium, with a new Aquatic Medical Room and Medical Pool within the new Ocean Wonders Shark! exhibit. There is a new dedicated laboratory, detailed monitoring capability for aquatic anesthesia cases and specialized equipment including an adjustable fish anesthesia wet table, a large shark anesthesia wet table, and tanks with isolated life support that permit care of aquatic patients requiring intensive care. A specially designed Medical Pool with a hydraulic floor enables transfer of animals, particularly large sharks, from the exhibit to the Medical Pool for examinations; animals are trained to voluntarily move into the pool on command. This facility vastly increases the ease with which we can treat large aquatic animals in emergencies, perform recheck examinations, share digital diagnostic imagery and allows for scheduled physicals such as regular ultrasound examinations for reproductive monitoring and annual preventive health examinations.

The acquisition, housing, quarantine and ultimate move of fish (especially sharks) to an exhibit is a delicate process. Movement entails closely monitoring water quality parameters of both quarantine and exhibit tanks to synchronize them, as well as move logistics. Capture of fish for relocation may require application of an anesthetic to an entire tank, sometimes thousands of gallons in size, to enable safe and efficient transfer. Fish transfer provides an opportunity to obtain blood, other samples, morphometric measurements and conduct quarantine examinations and reproductive research. Sand tiger sharks (*Carcharias taurus*) are a signature species of our exhibit and reproductive research of the species includes ultrasound evaluation of their reproductive tract and collection and analysis of semen samples. Obtaining baseline evaluations when sharks are moved to the exhibit are invaluable for future comparisons as the sharks mature, and hopefully reproduce, in our care. Moving larger sharks requires many people, coordination of their activities, and specialized equipment such as stretchers and cranes to accomplish the move safely!
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