



USAID
FROM THE AMERICAN PEOPLE



PREDICT **MONGOLIA**

One Health in action (2014-2020)



*Mongolia's One Health approach to avian influenza surveillance
in wild birds*

MONGOLIA

In Mongolia, the PREDICT project focused on improving the national capacity for wild bird surveillance and early detection of avian influenza in order to help address threats to domestic animals and human health. Wild birds are the evolutionary hosts for influenza viruses which cause a range of signs in people from mild illness to death. FAO estimates the global economic costs of losses in the livestock/poultry sector from highly pathogenic avian influenza since 2003 are in the billions of US dollars.

Located geographically where three major migratory flyways (East Asian-Australasian, Central Asian, and West Asian-East African Flyway) overlap, Mongolia is of key importance in understanding the role wild birds play in the maintenance and spread of influenza viruses including highly pathogenic avian influenza H5N1. Within Asia, Mongolia is a particularly ideal location to study the dynamics of wild bird influenza virus because the country has very low densities of domestic poultry compared to neighboring countries, supports large concentrations of waterfowl, and has important breeding, molting, and pre-migratory staging areas, thus the relative absence of poultry within the country provides a near unique opportunity to study the epidemiology of the virus in the absence of domestic influence.

Mongolia does not have a national or local wildlife authority, and thus lacks a wildlife disease surveillance and outbreak response system. The team worked with four national institutions (two in the human health sector and two in the animal health sector), strengthening the collaborations among Mongolia's existing platforms to address zoonotic diseases by incorporating field-based wildlife disease surveillance, laboratory screening of wildlife samples, and information sharing across One Health partners.

The country first experienced highly pathogenic avian influenza H5N1 outbreaks in 2005 and 2006, following the emergence of the H5N1 clade 2.2 viruses in wild bird populations at Qinghai Lake in China.

Mongolia then experienced a lull during 2007 and 2008, when no further outbreaks were detected in China. Then in 2009 a wave of outbreaks in central and western Mongolia occurred, with further outbreaks in Sukhbaatar Province in May 2010 and neighboring Tuva Republic in Russia in June 2010. This new virus, H5N1 clade 2.3.2, that circulated was distantly related to the one that caused earlier outbreaks, and likely represented a spillover from domestic sources, as earlier wild bird cases were detected in Hong Kong (2007/8), Japan (2008), and China (2009).

The movement of wild birds contributes to the global movement of these viruses and there is a need to continue avian influenza monitoring systems in wild bird populations. Monitoring is important to prevent spread of influenza viruses to domestic poultry and from poultry to humans as well as to prevent spill back of highly pathogenic influenza viruses from poultry to wild birds.

In this way, avian influenza was used as a model for building general zoonotic disease capacity in Mongolia and provided an important wild bird surveillance opportunity to prevent and to respond to outbreaks involving wildlife and wild birds.

The PREDICT project engaged at the national level with organizations, centers, and laboratories to implement testing for avian influenza using PREDICT protocols in Mongolia using a One Health approach:

- The National Influenza Center (NIC) - responsible for human health screening and reporting on Influenza Like Illnesses (ILI) throughout Mongolia and providing surveillance, outbreak response, and other laboratory diagnostic guidance to the National ILI system through direct connection to all provincial human hospitals.
- The National Center for Zoonotic Diseases (NCZD) - responsible for surveillance, monitoring and reporting of zoonotic diseases of high human concern

such as bubonic plague, rabies, anthrax, highly pathogenic avian influenza, emerging and re-emerging zoonotic diseases, and vector borne diseases.

- General Authority for Veterinary Services (GAVS) - responsible for National law on livestock and animal health thus oversees the National Strategy and Policy on animal health, guides and implements National level livestock disease surveillance, vaccination, post vaccination immunization and outbreak response. Oversees the State Central Veterinary Laboratory and all 21 provincial veterinary laboratories and their disease response and surveillance capacity.
- The State Central Veterinary Laboratory (SCVL) - responsible for all livestock and animal disease diagnosis and confirmation at the National level and has close working relationships with regional and global reference laboratories as well as guides and supports all provincial laboratories in 21 provinces of Mongolia. As a PREDICT partner, SCVL supported field team trainings that included safe sample collection, sample storage, cold chain, and appropriate PPE use. All the samples collected were tested at SCVL and positive samples were subtyped and further tested at the SCVL or partner laboratories.
- The team also worked at the local level engaging provincial level veterinary laboratories, centers for zoonotic disease, protected areas, and local environmental agencies. These partners are important players for One Health field surveillance, monitoring, response actions, and readiness. Annual field-based trainings were held that targeted the provincial level partners to strengthen their response, preparedness, and surveillance capacity. The annual trainings focused on wild bird identification, safe sample collection procedures, cold chain, sample storage, and PPE use, all critical elements of a zoonotic disease surveillance system.

LOCAL PARTNERS

- Environmental Protection Agencies in Dornod, Khovd, and Gobi Altai Provinces
- General Authority Veterinary Services (GAVS)
- Mongolian Academy of Sciences (MAS)
- National Center for Zoonotic Disease (NCZD)
- National Influenza Center (NIC)
- Protected Area Authorities including Khar Us Lake, Mongol Els, and Dariganga National Park
- Provincial Veterinary Laboratories in Arkhangai, Bulgan, Bayan-Ulgii, Dornod, Khentii, Khovd, Khuvsgul, Sukhbaatar, Uvs, Arkhangai, Bulgan, Bayan-Ulgii, Khentii, Khuvsgul, Khovd, and Uvs Provinces
- State Central Veterinary Laboratory (SCVL)
- University of California, Davis
- USAID
- Wildlife Conservation Society (WCS)



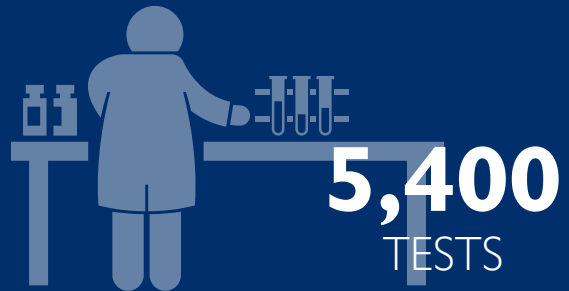
DEVELOPED the One Health Workforce by training more than 70 people in Mongolia.



OPERATIONALIZED One Health surveillance and sampled over 3.2K animals, helping minimize the spillover of zoonotic disease threats from animals into human populations.

LABORATORY STRENGTHENING

· State Central Veterinary Laboratory



DETECTED 5 unique subtypes of Influenza A virus



Global Health Security Agenda



**ARIUNBAATAR
BARKHASBAATAR**

Avian Specialist
Wildlife Conservation Society

“In 2016 I started working as an avian specialist on the PREDICT project while also working to complete my master’s degree on raptor populations in Mongolia. I led the spring and fall field sampling events for three regions in Mongolia and trained PREDICT partners in bird identification, survey methods, and safe handling of avian species. The surveys included shoreline transects, examinations of dead and sick birds, conducting post-mortem examinations, and collection of guano samples. I acquired a lot of field experience and wildlife disease knowledge from the PREDICT project, especially bird necropsy and sample collection.”



**ENKHTUVSHIN
SHIILEGDAMBA**

Country Coordinator
Wildlife Conservation Society

“I am the Wildlife Conservation Society Mongolia Program director for the last 6 years and leading environmental and conservation focused projects as well as livestock, wildlife and human health interface disease projects such as the PREDICT project. I am very proud to be part of the global PREDICT project and to be able to contribute some of my knowledge and capacity support not only to the project but also to the Mongolian professional organizations that partnered with us to build their capacity and knowledge and to support One Health.”



**BATCHULUUN
DAMDINJAV**

Laboratory Testing &
Diagnostic Liaison
Wildlife Conservation Society

“During the project, we organized an online training on gene sequencing and data analysis for SCVL employees with PREDICT experts. It was a great training opportunity and training video materials were provided for SCVL employees. The barcoding tests were done on all positive samples and on some targeted negative samples by Cytochrome B and COI specific PCR. Through the project, I learned the importance of sampling methods for field surveillance and genetic analysis, barcode testing, data cleaning, and data analysis.”

ACHIEVEMENTS

- One Health teams including specialists from the provincial zoonotic disease centers, veterinary units, and environmental agencies were trained to perform field sampling and data collection for avian influenza surveillance following field protocols.
- Samples from the field were successfully stored and transported with cold chain to the State Central Veterinary Laboratory where influenza virus detection and subtyping of influenza A positive samples was completed.
- One Health teams were successfully prepared and trained to quickly and efficiently respond to wildlife disease outbreaks in remote parts of Mongolia including Central, Eastern, and Western regions. Since 2016 they supported responses to Pestes des Petit Ruminants (PPR) disease outbreaks in wildlife and investigated a large-scale die-off of water birds.
- One Health cross-sectoral information sharing was strengthened by distributing test results and data on risk characterization from the project to all the national agencies that collaborate on zoonotic disease policy and surveillance in Mongolia including GAVS, NCZD, NIC, and SCVL.
- Investments in avian influenza field surveys and laboratory capacity building in Mongolia resulted in 66 sampling events at 26 sites between May 2016 and October 2018 and the collection of 3,243 samples that were tested for avian influenza virus. The surveys and collection of guano samples were focused on waterfowl, including swans, ducks, geese and shelducks, and brought laboratory scientists out in the field to improve their field expertise.
- Our work made a significant contribution in monitoring critical habitat for globally important populations of wild birds and raised interest among veterinary, human health, and environmental agency specialists alike on monitoring and conservation of wild avian species.

ONE HEALTH SURVEILLANCE



In Mongolia, sampling for avian influenza surveillance was performed at 26 sites (Fig 1) collecting 3,243 bird guano and tissue samples. The team also collected opportunistic swab samples from sick birds unable to fly, and performed necropsy examinations on dead birds that were encountered during field activities (Photo 1). Guano samples were collected from wild water birds including swans (*Cygnus sp.*), ducks (*Anas sp.*), geese (*Anser sp.*) and shelducks (*Tadorna sp.*). Opportunistic sampling was performed including oral swabs from 19 Cinereous vultures (*Aegypius monachus*), tissue samples from eight arctic herring gulls (*Larus smithsonianus*) and four common shelducks (*Tadorna tadorna*), and tissue or swab samples from one to two individuals of another seven species.

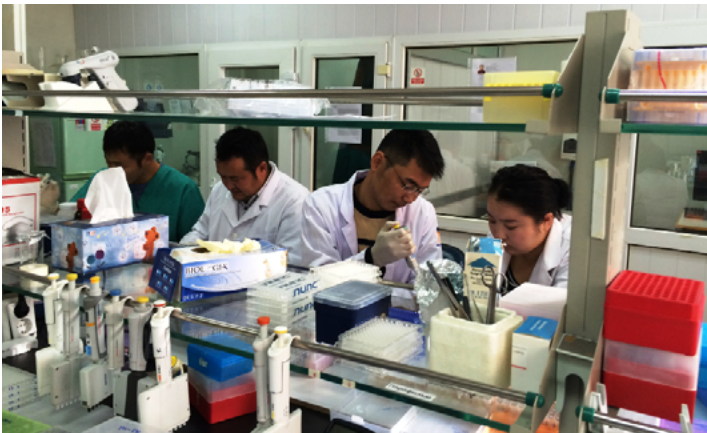
All samples were safely screened for influenza virus using PREDICT protocols at the State Central Veterinary Laboratory (SCVL) and positives were confirmed by cloning and sequencing of the PCR products. SCVL also performed barcoding to assist with host identification.

Testing of bird guano samples found 57 (1.8%) samples positive for influenza A and were further subtyped at the SCVL. Although none of the subtypes detected were highly pathogenic avian influenza, the findings of low pathogenic avian influenza viruses are important for understanding what is circulating in wild birds. The proportion of positives was significantly higher in the West (1.7%, n=874) and Central regions (3.0%, n=1371) compared to the Eastern region (0.1%, n=947). The H5N1 outbreaks previously reported in Mongolia were detected mostly in the Central and Western regions repeatedly in 2005, 2006 and 2009; while H5N1 was detected in the Eastern Region only in 2010. As with the number of positives, the number of subtypes detected was also higher in the Central and Western region as five subtypes detected, H2N2, H3N8, H4N6, H6N2, and H10N7; compared to only one subtype, H2N2, in the Eastern region. The proportion of positives also varied between sampling years, from a high of 3.9% in 2016, to 0.6% and 0.5% in 2017 and 2018 respectively. Within years, the fall season, including the months of August, September, and October, tended to have more positives (2.3%) than the spring season (1.2%), which included the months of April, May, and June. Finally, the highest proportion of positives by host were in shelducks (genus *Tadorna*, 2.9%), followed by herring gulls (genus *Larus*, 2.0%) and ducks (genus *Anas*, 1.8%).

Photo 1. Necropsy exam of a common shelduck at Sangiin Dalai Lake, Western Mongolia in August 2018 (credit: PREDICT/Mongolia)

VIRUS TABLE (2015-2019)

SAMPLING LOCATION (PROVINCE)	VIRUS	SPECIES	# OF POSITIVE INDIVIDUALS		
			TOTAL	SPRING SEASON	FALL SEASON
Arkhangai	Influenza A, subtype H10N7	Unidentified Anas Duck	1	0	1
	Influenza A, subtype H3N8	Ruddy Shelduck, Unidentified Anas Duck, Whooper Swan	19	12	7
Bulgan	Influenza A, subtype H3N8	Ruddy Shelduck, Unidentified Anas Duck	10	0	10
	Influenza A, subtype H4N6	Unidentified Anas Duck	1	1	0
Khovd	Influenza A, subtype H6N2	Unidentified Anser Goose	3	3	0
Khuvsgul	Influenza A, subtype H3N8	Ruddy Shelduck	2	0	2
	Influenza A, subtype H4N6	Ruddy Shelduck	8	0	8
Sukhbaatar	Influenza A, subtype H2N2	Ruddy Shelduck	1	1	0
Uvs	Influenza A, subtype H2N2	Unidentified Larus Gull	1	1	0
	Influenza A, subtype H4N6	Unidentified Anas Duck	4	0	4
Zavkhan	Influenza A, subtype H10N7	Ruddy Shelduck	7	0	7
Total			57	18	39



Photos 2 & 3 (L-R): Laboratory screening of samples at SCVL (credit: PREDICT/Mongolia); laboratory testing for influenza virus was conducted at SCVL using PREDICT protocols (credit: Ulaankhuu Ankhanbaatar).

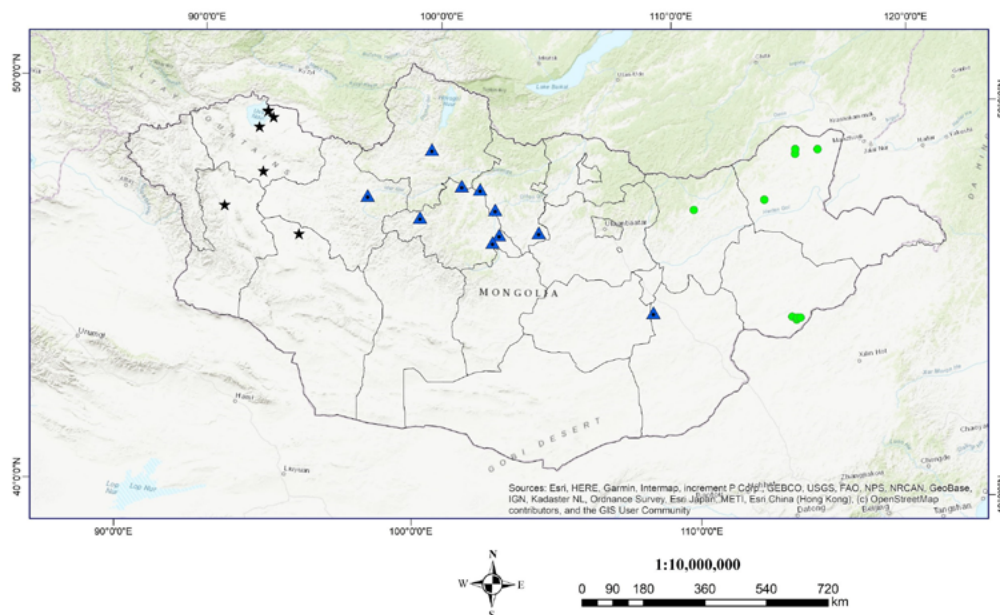


Figure 1. PREDICT surveillance sites in Mongolia, black stars, blue triangles, and green circles representing the Western, Central, and Eastern region sites respectively.

OUTBREAK PREPAREDNESS & RESPONSE

The PREDICT project worked with local partners to improve wild bird surveillance and to support early detection and rapid response to avian influenza outbreaks. This preparation paid off in August 2018 when a mass mortality event of wild birds of unknown cause occurred at Sangiin Dalai Lake, located in the far western region. The Sangiin Dalai Lake (47.40°N, 94.96°E) is a high saltwater lake located at the front edge of the Mongol Els sand dune in Khokhmorit Soum, Gobi-Altai Province, and is surrounded by sand dunes and small sandy hills.

In response to an emergency call from local partners the team performed sampling around the lake and met with local partners in the veterinary and environmental sectors on 25-27 August, 2018. Surveys included collection of guano samples and a 15km shoreline transect to count sick and dead birds. A total of 341 dead and sick birds, including 254 dead and 87 sick birds belonging to 12 species, were counted. Most were Common shelducks (n =170) and Ruddy shelducks (n = 129) (Table 2). A total of 85 samples were collected including 25 tissue samples, five oral swabs, five cloacal swabs from dead birds and 50 guano samples from geese.

Although avian influenza was later ruled out, the event demonstrated a strong One Health outbreak response involving key stakeholders. The cause of this die-off remains unknown. Testing found that animals were negative for avian influenza and Newcastle disease virus, an avian paramyxovirus. In-country laboratory and field teams determined that avian botulism was the most likely cause of the large-scale die-off given the negative viral test results and absence of gross or histological lesions in birds. Botulism testing was not performed to confirm suspicions due to limited capacity and resources.



Photo 4. Mass die-off of wild birds around Sangiin Dalai Lake, Gobi-Altai Province (credit: PREDICT/Mongolia)

Table 2. DEAD & SICK BIRDS LIST AT SANGIIN DALAI LAKE, 25-27 AUGUST, 2018

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	DEAD	SICK	TOTAL
<i>Tadorna tadorna</i>	Common Shelduck	121	49	170
<i>Tadorna ferruginea</i>	Ruddy Shelduck	102	27	129
<i>Chroicocephalus ridibundus</i>	Black-headed Gull	12	1	13
<i>Recurvirostra avosetta</i>	Pied Avocet	1	4	5
<i>Larus mongolicus</i>	Mongolian Gull	1	2	3
<i>Anas platyrhynchos</i>	Mallard	2		2
<i>Anas acuta</i>	Northern Pintail	1	1	2
<i>Himantopus himantopus</i>	Black-winged Stilt	1		1
<i>Sterna hirundo</i>	Common Tern	1		1
<i>Calidris minuta</i>	Little Stint		1	1
<i>Aythya fuligula</i>	Tufted Duck		1	1
<i>Calidris temminckii</i>	Temminck's Stint		1	1
<i>Unknown species</i>		12		12
<i>Total</i>		254	87	341

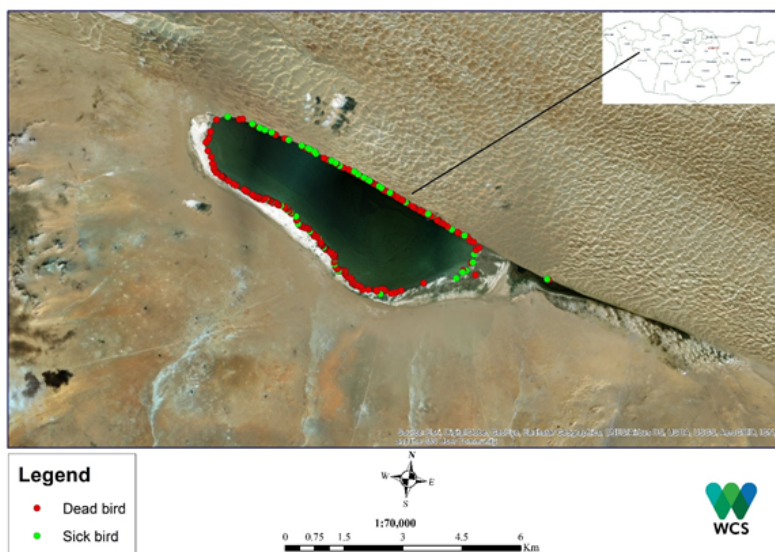


Figure 2. Map of dead and sick birds at Sangiin Dalai Lake, August 25-27, 2018.



INTEGRATING WILDLIFE CONSIDERATIONS INTO PESTE DES PETITS RUMINANTS CONTROL

In early January 2017, environmental rangers were encountering an unprecedented number of sick and dead saiga antelope (*Saiga tatarica mongolica*) – a critically endangered species - as they drove their survey transects. It was quickly determined that the disease killing the saiga was Peste des Petits Ruminants (PPR), a paramyxovirus that had first been confirmed in Mongolian sheep and goats in 2016. The outbreak of PPR in Mongolian saiga represents the first time the disease was recorded in a free-ranging antelope species and took both the wildlife conservation and livestock health experts by surprise. The confirmation of PPR virus in Mongolian saiga, and other wild ungulate species in January 2017, was an indication that the large-scale vaccination of livestock for PPR completed in October 2016 had not been effective in stopping on-going transmission in Mongolia, putting non-vaccinated sheep and goats and susceptible wildlife species at risk of infection.

Learn more here: bit.ly/OH-study-Mongolia

For more information
view the interactive report at
p2.predict.global



USAID
FROM THE AMERICAN PEOPLE


UC DAVIS
VETERINARY MEDICINE
One Health Institute



EcoHealth
Alliance



METABIOTA™



Smithsonian
Institution