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Reducing Pandemic Risk, Promoting Global Health

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Vietnam

Vietnam is located in Southeast Asia and shares borders with China to the north and Lao PDR and Cambodia to the west. The country spans 330,951 km² (Vietnam General Statistics Office, Ministry of Planning and Investment), and as of 2012, the population of Vietnam was approximately 90 million (World Bank 2014). Vietnam is rich in biodiversity with approximately 1,534 known species of amphibians, birds, mammals, and reptiles (Mongabay 2006). However, many of Vietnam’s iconic wildlife, like its endemic langur species, have been hunted close to extinction (Stone 2014). Human population growth and economic development have also driven large-scale land-use change with human encroachment into natural habitats putting additional pressure on wild species.

Vietnam has capitalized on its geographic position to play a major role in wildlife trade in the region and is known as a trade hub for wildlife in Indochina. A major component of the illegal wildlife trade thrives on the domestic and international demand for wildlife as food, targeting taxa from mammals to birds (WCS 2012). Commercial wildlife farming has also been developed in Vietnam and has rapidly expanded in numbers, species, and scale since 2000 when development of wildlife farms was encouraged by national action plans in Vietnam and supported by provincial directives (Thomson 2008). The expansion of wildlife farming has outpaced the establishment of strong enforcement of regulations and monitoring capacity of the authorities leading to reports of significant numbers of animal escapes, direct exploitation of the wild population to supplement farm stock, and poor provision of veterinary care (WCS 2008).

As a country heavily involved in the trade of wildlife (hunting, farming, and consuming wildlife locally; sourcing wildlife from neighboring countries; and trafficking wildlife across the region) and with a history of land-use change and population growth, the interfaces among wildlife,
livestock, and humans in Vietnam are intense. PREDICT in Vietnam focused on conducting and building capacity for disease surveillance in wildlife at these high-intensity human-wildlife interfaces to detect pathogens of pandemic potential. The majority of surveillance was focused along the wildlife trade value chain, given the multiple opportunities for pathogen spillover, amplification, and spread. PREDICT, in collaboration with local authorities and research institutions, collected samples from wildlife for sale in markets, slaughtered for human consumption in restaurants, raised on wildlife farms, and confiscated by the authorities from the illegal wildlife trade. PREDICT worked with national laboratories and universities to develop and apply protocols for disease detection in these samples and to identify novel viral pathogens.

PARTNERS
PREDICT partners in Vietnam included the Wildlife Conservation Society (WCS), USAID, Department of Animal Health (DAH) of the Ministry of Agriculture and Rural Development (MARD), and the Hanoi University of Agriculture (HUA), now called the Vietnam National University of Agriculture.

Other local partners included:

Socialist Republic of Vietnam
• Regional Animal Health Office No. 6 (RAHO6)
• National Center for Veterinary Diagnostics (NCVD)
• Lam Dong Province Forest Protection Department (FPD)
• Dong Nai Province Forest Protection Department
• Soc Trang Province Sub-Department of Animal Health
• Dong Thap Province Sub-Department of Animal Health

Non-governmental research partners
• The Cat Ba Langur Conservation Project
• Animals Asia Foundation
• Carnivore and Pangolin Conservation Program

MAJOR ACHIEVEMENTS
• Advanced adoption of the One Health approach in Vietnam though a series of events and the establishment of a network to support Vietnam’s One Health activities, including supporting Vietnam’s participation in global One Health initiatives like the OIE Global Conference on Wildlife “Animal health and biodiversity: Preparing for the future”. These activities were convened to increase awareness of the importance of wildlife diseases and the risk that human behaviors at the wildlife-human interface contribute to increasing the transmission and emergence of zoonotic diseases (see Success Stories for more information).
- Initiated disease surveillance on wildlife farms in Vietnam through a collaborative effort between the DAH and the FPD in the pilot province of Dong Nai in southern Vietnam, which has one of the highest densities of wildlife farms in the country (see Success Stories for more information).

- Established capacity to safely conduct wildlife pathogen surveillance in Vietnam through extensive training on animal handling, sample collection, and biosafety. In total, 150 animal health officers received field-based training under PREDICT activities. Training included safe animal capture and handling, sample collection and storage, biosafety, and use of PPE.

- Raised awareness of the risk of disease spillover, amplification, and spread through wildlife trafficking by incorporating content on disease risks at the wildlife-human interface into training programs delivered to over 200 FPD and other enforcement officials in Vietnam.

- Established key laboratory capacity for virus detection at the HUA National Key Laboratory of Veterinary Biotechnology and the DAH RAHO6 Laboratory in Ho Chi Minh City. The two facilities provide national coverage for these services. Protocols for PCR screening for ten viral families (arenaviruses, flaviviruses, paramyxoviruses, hantaviruses, bunyaviruses, coronaviruses, henipaviruses, filoviruses, herpesviruses, and rhabdoviruses) were implemented with training also extended to the NCVD in Hanoi.

SUCCESS STORIES

Supporting the One Health Approach in Vietnam

PREDICT co-organized and supported a series of events in Vietnam that expanded the One Health network across the country and promoted a One Health approach to understanding and preventing the emergence of diseases of pandemic potential. The kick-off event held in March 2011 was a workshop entitled “Wildlife and Emerging Infectious Diseases in Vietnam – Current Activities and Visions for the Future” that attracted over 100 participants from across the country, representing the human health, animal health, and environmental sectors. The workshop, with its focus on wildlife health, was the first of its kind to be convened in Vietnam.

Photo left: Collecting samples from fruit bats in Soc Trang Province.
Photo right: Practicing wildlife sample collection methods during the Dong Nai Wildlife Health Training.
and facilitated the establishment of a network of human and animal health and wildlife professionals. The participants assessed prior and on-going research in the area of wildlife health and identified gaps in Vietnam’s capacity to identify, investigate, diagnose, and respond to disease outbreaks with wildlife involvement. The gap analysis informed the development of PREDICT training activities and capacity building in the area of wildlife disease surveillance and pathogen detection in Vietnam. The gap analysis also guided the identification of areas of research and infectious disease challenges that would benefit from a One Health approach. The One Health network continues to be engaged in addressing some of the most critical challenges at the interface of wildlife, livestock, and human health in Vietnam as outlined through a few examples below.

PREDICT and network members contributed to the development of the “Vietnam Integrated National Operational Program on Avian Influenza, Pandemic Preparedness and Emerging Infectious Diseases (AIPED), 2011-2015” through a series of workshops and meetings organized by MARD, the Partnership for Avian and Human Influenza, and USAID. PREDICT co-organized the workshop entitled “Developing a ‘One Health’ approach for the period 2011-2015: addressing high impact infectious disease risks at the animal-human-environment interface” which was instrumental in establishing One Health as an important component of the Vietnam pandemic preparedness strategic plan, in particular highlighting the very important need for improved communication among the wildlife, livestock, and human health sectors.

PREDICT and network members provided support to PREVENT and other Emerging Pandemic Threat project partners around the topic of biosecurity on wildlife farms in Vietnam and participated in the “Expert Consultation Meeting: Strengthening Wildlife Farm Biosecurity and Supporting the Development of Good Production Practices” workshop in January 2013. As a direct follow-up to the workshop, PREDICT and network members joined the wildlife farming biosecurity and conservation subcommittee of the Vietnam Bio-Security Working Group, a collaborative effort between the Department of Livestock Production of MARD and the Food and Agriculture Organization of the United Nations (FAO) in Vietnam.

National ‘One Health’ conferences became biennial events in Vietnam with the 2013 event, which focused on the implementation of a One Health approach to infectious disease risks at the human-animal-ecosystem interface, held in Hanoi April 4-5, 2013. The One Health network in Vietnam
also kept in touch and informed through the distribution of PREDICT One Health Media Digest (digital media stories on wildlife, domestic livestock, and human disease outbreaks in Vietnam and internationally) which was launched in 2011. The recipients included the One Health network members, 94 individuals from government agencies, academic institutions, multi-lateral and donor organizations, NGOs, and other interested individuals.

**PREDICT Initiates Disease Surveillance on Wildlife Farms in Vietnam**

The DAH and the FPD joined forces to conduct disease surveillance on wildlife farms in Dong Nai Province in southern Vietnam from November 2013 through March 2014. Dong Nai Province borders Ho Chi Minh City and has one of the highest densities of wildlife farms in the country with over 1,000 farms raising reptiles, wild rodents, primates, birds, carnivores, and ungulates. The collaborative effort represented the first formal activity implemented jointly by the DAH and the FPD to address disease in wildlife. The joint surveillance effort was both an important example of operationalizing One Health in Vietnam and an important training opportunity as described below.

Before the launch of the surveillance effort, PREDICT-Vietnam held a series of meetings with Dong Nai Province officials to develop a field-based training program on wildlife diseases and conduct biosecurity risk assessments for wildlife and veterinary practitioners in the province to prepare them for the planned wildlife farm disease surveillance effort.

The wildlife health training was held in November 2013 at the launch of the wildlife farm surveillance effort and was co-organized and supported by PREDICT and RESPOND. The training covered wildlife disease diagnosis and management, handling of samples from wildlife for pathogen detection, the use of personal protective equipment (PPE), and biosecurity risk assessments on farms. Training participants, 38 in total, included rangers and officials from the Dong Nai FPD, veterinarians and animal health officers from the Dong Nai sub-DAH, and wildlife farm owners. Trainers included lecturers from the Vietnam One Health University Network (VOHUN), PREDICT, and RESPOND staff. The field-based component of the training included conducting biosecurity assessments and collecting samples from wildlife species on three farms and one Department of Agriculture and Rural Development (DARD) rescue center. A total of 162 samples (primarily feces and environmental samples) were collected from seven different species of wildlife, including the common palm civet, Malayan porcupine, wild pig, pig-tailed macaque, crab-eating macaque, stump-tailed macaque, porcupine, civet, and bamboo rats.

As a direct follow-up to the November 2013 wildlife disease surveillance and wildlife farm biosecurity training, PREDICT worked with Dong Nai DARD in March 2014 to provide extensive field-based training on disease surveillance on wildlife farms to local district level rangers and veterinarians. Local veterinarians and forestry rangers joined the PREDICT team to collect samples from wildlife farms within their district’s jurisdictional boundaries, visiting on average three farms per district, and collecting approximately 100 samples per district. The sampling was focused on PREDICT priority species, including bamboo rats, porcupines, and
nonhuman primates. Some sampling of civets was performed at the request of DARD. Overall PREDICT and DARD staff covered 11 districts, collecting samples from 539 individuals. Training participants included 13 DARD Forestry Protection Officers (one female and 12 male) and nine Veterinary Officers (one female and eight male). All of the local veterinarians and forestry rangers had participated in the November 2013 introductory training held in Dong Nai Province center. The March 2013 field-based training gave participants the opportunity to review and practice sampling methods (collection, labeling, storage, and transport), use of PPE, and the collection of saliva samples from nonhuman primates. It also reinforced these critical skills for officers on the front lines of wildlife disease surveillance and outbreak response.

**CAPACITY BUILDING**

**Wildlife Disease Surveillance**

PREDICT wildlife disease surveillance capacity building activities in Vietnam focused on building the field-based skills required for wildlife identification, safe handling, and sample collection for pathogen detection. PREDICT provided field-based training in wildlife disease surveillance for provincial-level and district-level animal health officers in the Mekong Delta region of Vietnam through their participation in sampling events in markets, restaurants, bat guano farms, and religious sites in the region. Veterinary students from HUA were trained in collection of a variety of specimen types from wildlife and environmental samples in Hanoi area restaurants, as well as the correct use of PPE. In addition, non-invasive techniques for the collection of saliva samples from nonhuman primates were taught to a range of animal health and wildlife managers in the north and south of the country.

PREDICT collaborated with VOHUN and RESPOND to train provincial-level and district-level veterinary and wildlife/forestry officers to conduct disease surveillance and biosecurity risk assessments on wildlife farms in Dong Nai Province in southern Vietnam, and a range of professionals working in wildlife rescue centers across the country were trained to collect samples from wildlife for pathogen detection. In the early stages of PREDICT work in Vietnam, the team focused on wildlife species identification training with animal health officers and produced a poster focused on the identification of PREDICT priority species for surveillance.

**Laboratory Diagnostics**

PREDICT laboratory diagnostics capacity building in Vietnam focused on training in molecular diagnostics, laboratory biosafety, and optimizing viral screening protocols for wildlife samples, as well as the provision of additional equipment and needed supplies and reagents for in-country laboratories. PREDICT laboratory capacity building trainings in Vietnam were kicked off with a “Laboratory Biosafety for Wildlife Diagnostics” workshop co-hosted by HUA’s Faculty of Veterinary Medicine for 16 laboratory and faculty members from HUA and two laboratory staff each from NCVD, RAHO6 Laboratory, and Oxford University Clinical Research Unit (OUCRU), as well as one laboratory expert from FAO. The initial workshop was followed by an introductory and advanced training in PREDICT molecular diagnostics.

PREDICT molecular diagnostics trainings covered a wide range of new technologies for pathogen detection and new sample preservation methods. The use of appropriate sample storage equipment and protocols was emphasized, and the use of new laboratory equipment was covered. The PREDICT PCR positive control was introduced, and, as a result of this
series of trainings and additional one-on-one support, we successfully established capacity for screening for arenaviruses, flaviruses, paramyxoviruses, hantaviruses, bunyaviruses, coronaviruses, herpesviruses, henipaviruses, filoviruses, and rhabdoviruses. The HUA National Key Laboratory of Veterinary Biotechnology and the RAHO6 Laboratory in Ho Chi Minh City together now provide national coverage for these services. Training and the PREDICT PCR positive control were also extended to the NCVD in Hanoi.

Laboratory infrastructure for wildlife pathogen detection in Vietnam was supported by PREDICT with the provision of ultra-low temperature freezers, high speed centrifuges, and a range of sample processing equipment. In addition, rack systems and other equipment were installed to improve sample management and safe storage for the ultralow freezers placed in the HUA National Key Laboratory of Veterinary Biotechnology and the RAHO6 Laboratory in Ho Chi Minh City.

**Wildlife Pathology Regional Training**

PREDICT held the “First Regional Wildlife Pathology Workshop” in Asia in partnership with HUA and Smithsonian Institution. Twenty-five government and university pathologists (19 from Vietnam, three from Laos, and three from Cambodia) were trained in basic cytology, PPE use, necropsy skills, sample collection for disease investigation, introduction to histopathology, and advanced molecular diagnostics. Seventy-eight participants attended the morning theory sessions of the workshop. The workshop was hosted by the Faculty of Veterinary Medicine, HUA, with funding and training development provided by PREDICT.

**Disease Risks Associated with Wildlife Trade**

PREDICT collaborated with the WCS Vietnam Country Program to create and deliver a training module for wildlife law enforcement officials that introduced the One Health concept.
and the human health risks associated with the wildlife trade, which is a significant wildlife-human interface in Vietnam. The module was presented at five wildlife law enforcement training workshops with government staff from the following departments and ministries in Vietnam: DAH, Department of Livestock Production, National Institute of Animal Husbandry, Vietnam Administration of Forestry, Forestry Directorate, and National Institute of Veterinary Research from MARD; Border Security Station from the Ministry of Defense; Vietnam Customs Department from the Ministry of Finance; Market Control Department from the Ministry of Industry and Trade; Environmental Police Department, Traffic Police Department, and Department of Agriculture Security from the Ministry of Public Security; Vietnam Environment Administration from the Ministry of Natural Resources and Environment; and People’s Procuratorate of the Supreme People’s Procuratorate.

**SURVEILLANCE**

Over 2,054 animals were sampled at high-risk disease transmission interfaces during 90 sampling events across Vietnam (Figure 1). Animals sampled included 1,288 rodents, 366 bats, 42 nonhuman primates, and 358 animals in other taxa (Figure 2).

Wildlife surveillance was conducted in partnership with the DAH and FPD of MARD and a number of non-governmental wildlife conservation organizations. High-risk disease transmission interfaces targeted for sampling included markets where live animals are sold, restaurants serving wild meat, wildlife farms, wildlife rescue centers/sanctuaries, and sites with wildlife present in and around human dwellings (Table 1). Sampling sites were distributed across Vietnam from the Mekong River Delta region in the south to sites in the north, including the national capital, Hanoi.

![Figure 1. Sites where PREDICT conducted virus surveillance in wildlife taxa at high-risk disease transmission interfaces between wildlife and humans.](image-url)
Table 1. Number of animals sampled according to targeted transmission interfaces.

<table>
<thead>
<tr>
<th>Interface</th>
<th>Nonhuman Primates</th>
<th>Rodents and Shrews</th>
<th>Bats</th>
<th>Other Taxa</th>
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</thead>
<tbody>
<tr>
<td>In or near human dwellings</td>
<td>0</td>
<td>0</td>
<td>366</td>
<td>0</td>
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<td>Markets</td>
<td>0</td>
<td>372</td>
<td>0</td>
<td>0</td>
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<td>Restaurants</td>
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<td>298</td>
<td>0</td>
<td>132</td>
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<td>Wildlife trade</td>
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<td>189</td>
<td>0</td>
<td>0</td>
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<td>Farmed wildlife</td>
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<td>429</td>
<td>0</td>
<td>153</td>
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<td>Zoos and sanctuaries</td>
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<td>0</td>
<td>0</td>
<td>73</td>
</tr>
<tr>
<td>Total:</td>
<td>42</td>
<td>1288</td>
<td>366</td>
<td>358</td>
</tr>
</tbody>
</table>

Figure 2. Number of animals sampled by taxa.

A primate is chewing on a swab during a nonhuman primate sampling trip at Bao Son Zoo, Hanoi.
DISEASE OUTBREAK RESPONSE AND PREPAREDNESS
PREDICT provided field-based training for forestry and veterinary officers on the “front lines” of disease outbreak events in wild and domestic animal populations in Vietnam. The capacity developed for wildlife surveillance and laboratory diagnostics is now available to apply to disease outbreak response.

REFERENCES