Global Health Security: Utilizing the One Health Approach to Control COVID-19 & *Disease X*

Global Health Security Agenda

3 Risks

- Emerging organisms
- Drug resistance
- Intentional creation

3 Opportunities

- Public health framework
- New lab and surveillance tools
- Successful outbreak control

3 Priorities

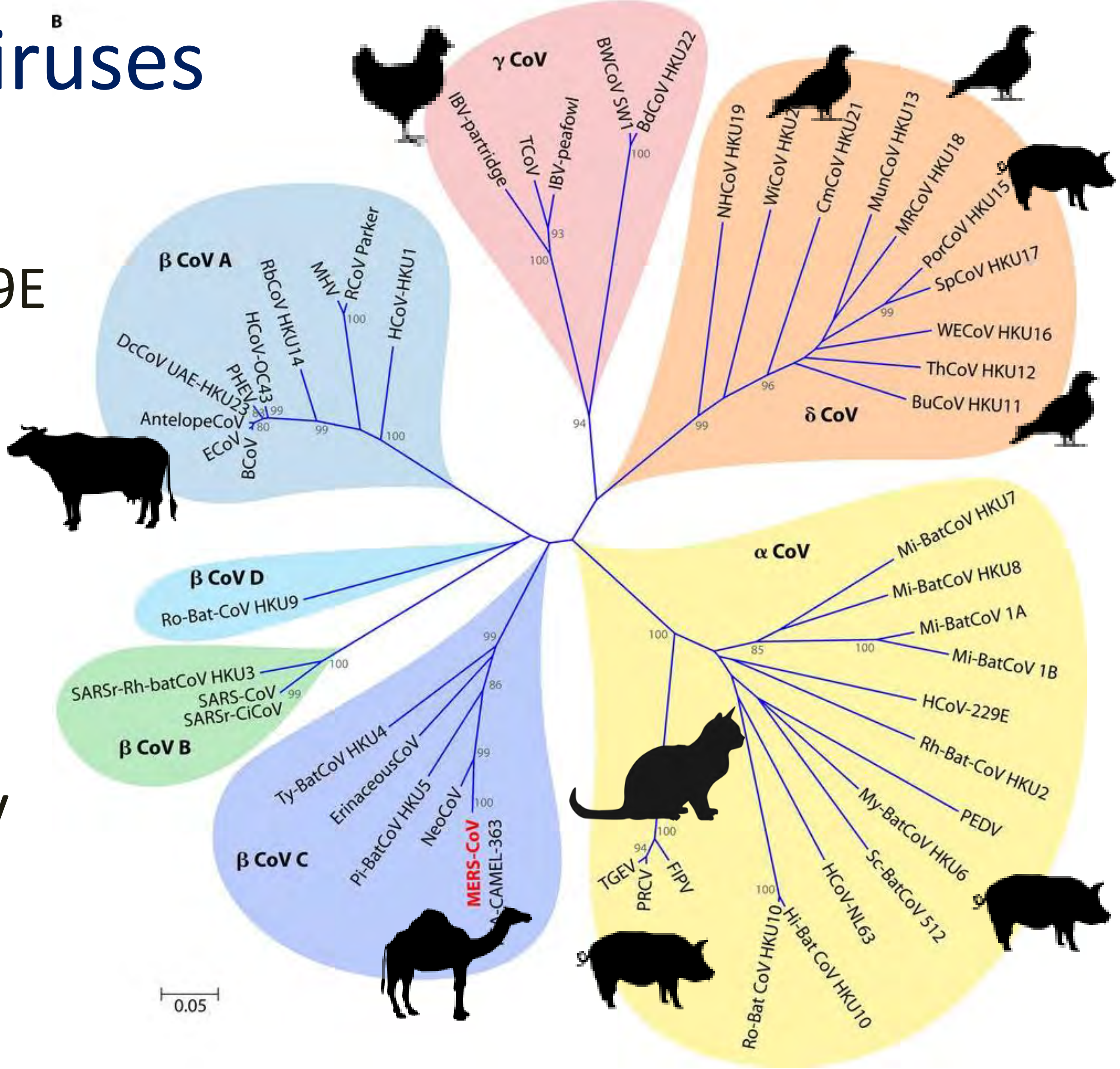
- Prevent wherever possible
- Detect rapidly
- Respond effectively

Vision: A world safe and secure from global health threats posed by infectious diseases, whether natural, deliberate, or accidental.

Zoonotic Origin of Coronaviruses

- 7 known Human Coronaviruses
  - Mild disease: HKU1, OC43, NL63, 229E
  - Severe outbreaks: SARS-CoV, MERS-CoV, SARS-CoV2 (COVID-19)
  - Almost all have zoonotic origins or circulate in animals:

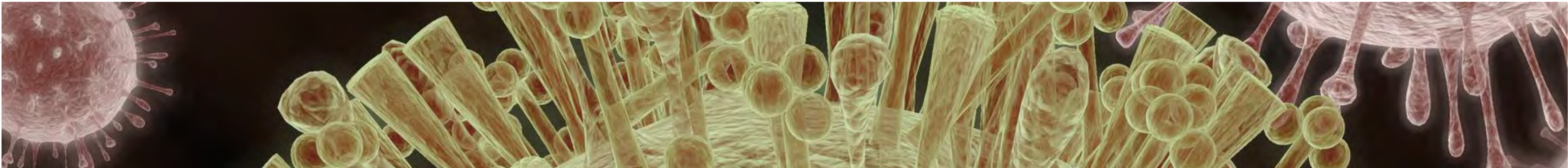
    (bats, camels, cattle, civets?)
- Non-human CoVs such as porcine epidemic diarrhea virus (PEDV) may have emerged by host switching
- One of the most impactul viral families in veterinary medicine



Jasper F. W. Chan et al. Clin. Microbiol. Rev. 2015; doi:10.1128/CMR.00102-14

Why should we protect bats?

- Protect biodiversity & ecosystems
  - Insectivorous – control pests
  - Pollinators – promote agricultural
  - Seed dispersers – connect fragmented landscapes
- Attempts to reduce populations:
  - Generally unsuccessful
  - Encourage recruitment of susceptibles, increasing transmission potential
  - Allow immigration from other areas
  - Stress populations, increasing virus shedding



PREDICT

USAID
FROM THE AMERICAN PEOPLE

6.8K

DEVELOPED the One Health Workforce by training more than 6,800 people in over 30 countries.

>60
LABS

STRENGTHENED laboratory systems and zoonotic disease detection capabilities in over 60 labs around the world.

164K

OPERATIONALIZED One Health surveillance and sampled over 164K animals and people, helping minimize the spillover of zoonotic disease threats from animals into human populations.

949
NOVEL

217
KNOWN

DETECTED over 1,100 unique viruses, including zoonotic diseases of public health concern such as Bombali ebolavirus, Zaire ebolavirus, Marburg virus, and MERS- and SARS-like coronaviruses.

PREDICT PARTNERS: USAID FROM THE AMERICAN PEOPLE · UC DAVIS VETERINARY MEDICINE One Health Institute · WCS · EcoHealth Alliance · METABIOTA™ · Smithsonian Institution

Laboratory Capacity and COVID-19 Response

- PREDICT improved testing capacity in 67 labs in 36 countries
- Built a network of linkages between laboratories, countries and government ministries
- Laboratories have additional tools and the ability to detect newly emerging viruses when assays or sequences do not yet exist
- Importance of these skills was underscored following the emergence of SARS CoV-2 in China
- Teams around the world able to call on the PREDICT network to share experience using PREDICT assays to detect the new virus & provide technical assistance to disease control plans

Ongoing Obstacles

ONE HEALTH WORKFORCE CAPACITY STRENGTHENING


AFROHUN


Knight's Landing

USAID
FROM THE AMERICAN PEOPLE

UCDAVIS
One Health Institute
School of Veterinary Medicine

OHCEA
Championing One Health

SEAOHUN
Southeast Asia One Health University Network

EcoHealth Alliance

Ata Health Strategies

ICAP
Columbia University Mailman School of Public Health

Berkeley
UNIVERSITY OF CALIFORNIA

Project ECHO®

UCI University of California, Irvine

GLOBAL
VIROME
PROJECT

The Global Virome Project (GVP) is an innovative 10-year partnership to detect the majority of our planet's unknown viral threats. It will pivot our approach from responding to outbreaks to proactively preparing for them. The GVP will mark the beginning of the end of the Pandemic Era.

Spillover and Wildlife Trade for Consumption: Rethinking our Relationship with Wildlife and Wild Places

Prof. Dr. med.vet. Chris Walzer
Wildlife Conservation Society
VetMed Univ. Vienna, Austria

What **do** we know?

- Zoonoses are diseases the move between animals and humans
- Emerging Infectious Diseases [EID] are dominated by zoonoses
- 72% of all zoonotic EIDs originate in wildlife
- EID frequency is increasing
  - HIV, EBOLA, H1N1, SARS, NIPAH, HENDRA, H7N9

Furuse *et al. Virology Journal* 2010, **7**:52
http://www.virologyj.com/content/7/1/52

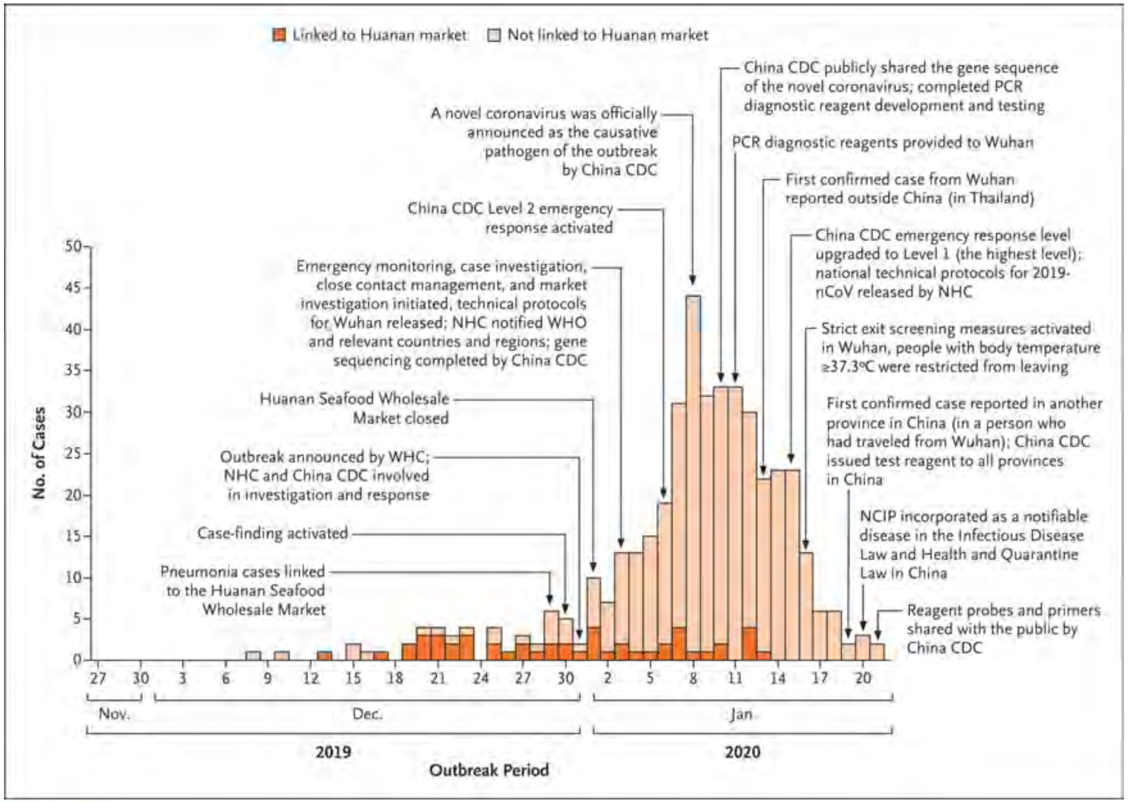
VIROLOGY JOURNAL

SHORT REPORT **Open Access**

Origin of measles virus: divergence from rinderpest virus between the 11th and 12th centuries

Yuki Furuse, Akira Suzuki, Hitoshi Oshitani*

What **do** we know?



Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study

Nanshan Chen*, Min Zhou*, Xuan Dong*, Jieming Qu*, Fengyun Gong, Yang Han, Yang Qiu, Jingli Wang, Ying Liu, Yuan Wei, Jia'an Xia, Ting Yu, Xinxin Zhang, Li Zhang

Summary

Background In December, 2019, a pneumonia associated with the 2019 novel coronavirus (2019-nCoV) emerged in Wuhan, China. We aimed to further clarify the epidemiological and clinical characteristics of 2019-nCoV pneumonia.

Methods In this retrospective, single-centre study, we included all confirmed cases of 2019-nCoV in Wuhan Jinyintan Hospital from Jan 1 to Jan 20, 2020. Cases were confirmed by real-time RT-PCR and were analysed for epidemiological, demographic, clinical, and radiological features and laboratory data. Outcomes were followed up until Jan 25, 2020.

Findings Of the 99 patients with 2019-nCoV pneumonia, 49 (49%) had a history of exposure to the Huanan seafood market. The average age of the patients was 55·5 years (SD 13·1), including 67 men and 32 women. 2019-nCoV was detected in all patients by real-time RT-PCR. 50 (51%) patients had chronic diseases. Patients had clinical manifestations of fever (82 [83%] patients), cough (81 [82%] patients), shortness of breath (31 [31%] patients), muscle ache

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https://doi.org/10.1016/S0140-6736(20)30211-7

*Contributed equally

Tuberculosis and Respiratory Department (Prof N Chen MD, X Dong PhD, Y Wei MD, J Xia MD, T Yu MD, Prof L Zhang MD), Infection Disease Department (F Gong MD, J Wang MD), Science and Education Department (Y Han PhD), and

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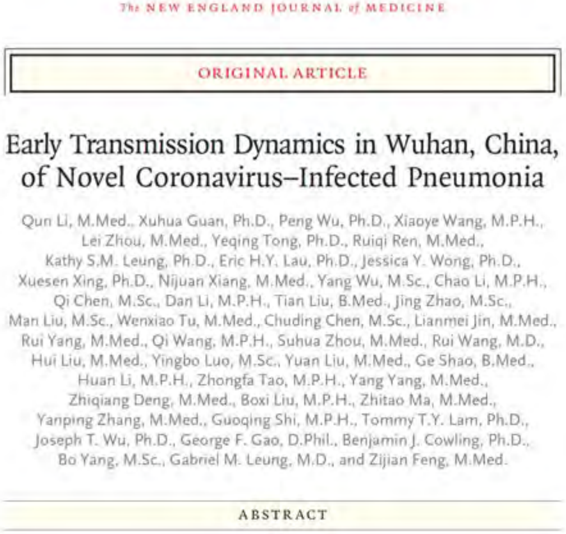


The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

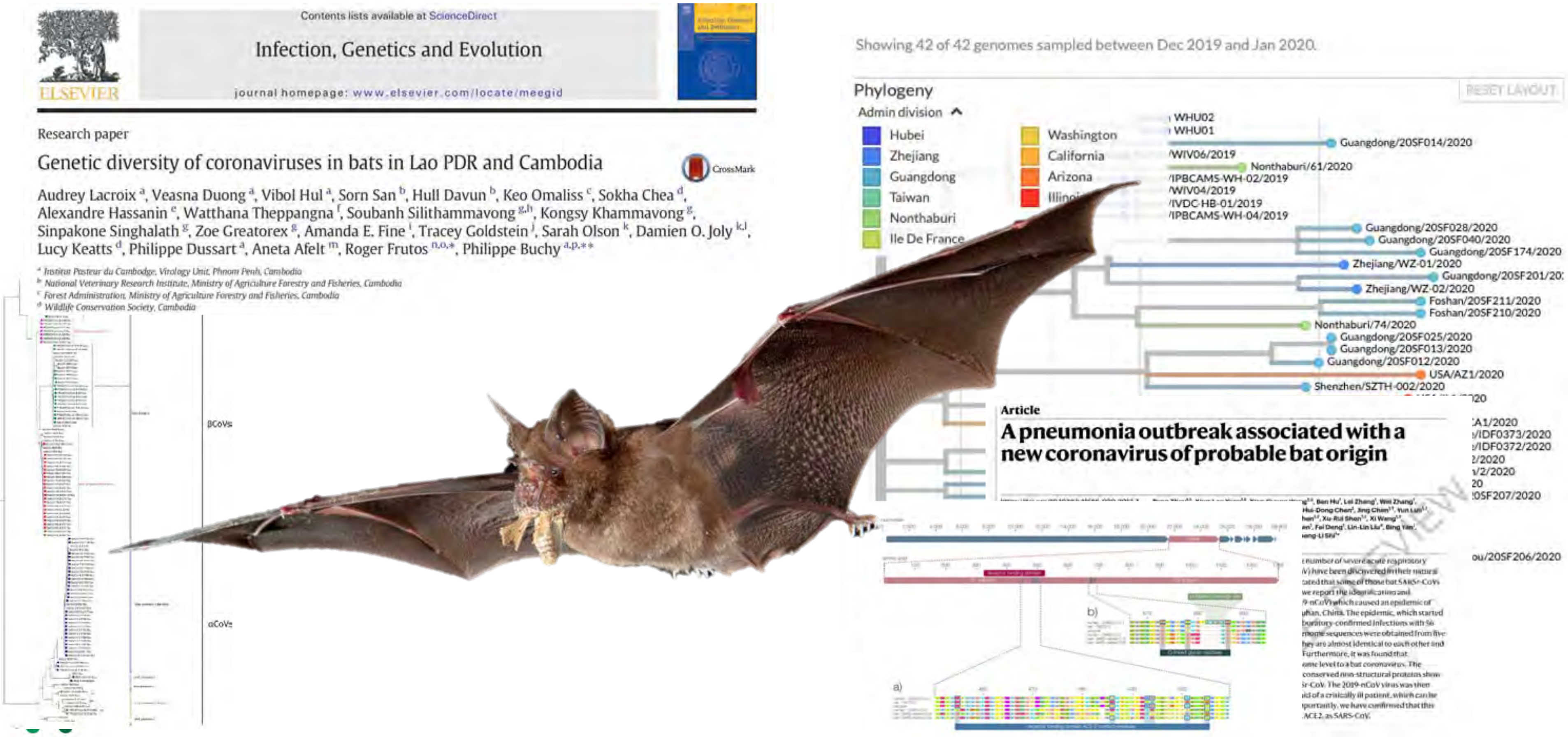
Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia

Qun Li, M.Med., Xuhua Guan, Ph.D., Peng Wu, Ph.D., Xiaoye Wang, M.P.H., Lei Zhou, M.Med., Yeqing Tong, Ph.D., Ruiqi Ren, M.Med., Kathy S.M. Leung, Ph.D., Eric H.Y. Lau, Ph.D., Jessica Y. Wong, Ph.D., Xuesen Xing, Ph.D., Nijuan Xiang, M.Med., Yang Wu, M.Sc., Chao Li, M.P.H., Qi Chen, M.Sc., Dan Li, M.P.H., Tian Liu, B.Med., Jing Zhao, M.Sc., Man Liu, M.Sc., Wenxiao Tu, M.Med., Chuding Chen, M.Sc., Lianmei Jin, M.Med., Rui Yang, M.Med., Qi Wang, M.P.H., Suhua Zhou, M.Med., Rui Wang, M.D., Hui Liu, M.Med., Yingbo Luo, M.Sc., Yuan Liu, M.Med., Ge Shao, B.Med., Huan Li, M.P.H., Zhongfa Tao, M.P.H., Yang Yang, M.Med., Zhiqiang Deng, M.Med., Boxi Liu, M.P.H., Zhitao Ma, M.Med., Yanping Zhang, M.Med., Guoqing Shi, M.P.H., Tommy T.Y. Lam, Ph.D., Joseph T. Wu, Ph.D., George F. Gao, D.Phil., Benjamin J. Cowling, Ph.D., Bo Yang, M.Sc., Gabriel M. Leung, M.D., and Zijian Feng, M.Med.

ABSTRACT


Friso

What **do** we know?



Contents lists available at ScienceDirect

Infection, Genetics and Evolution

journal homepage: www.elsevier.com/locate/meegid

Research paper

Genetic diversity of coronaviruses in bats in Lao PDR and Cambodia

Audrey Lacroix [a], Veasna Duong [a], Vibol Hul [a], Sorn San [b], Hull Davun [b], Keo Omaliss [c], Sokha Chea [d], Alexandre Hassanin [e], Watthana Theppangna [f], Soubanh Silithammavong [g,h], Kongsy Khammavong [g], Sinpakone Singhalath [g], Zoe Greatorex [g], Amanda E. Fine [i], Tracey Goldstein [j], Sarah Olson [k], Damien O. Joly [k,l], Lucy Keatts [d], Philippe Dussart [a], Aneta Afelt [m], Roger Frutos [n,o,*], Philippe Buchy [a,p,**]

[a] Institut Pasteur du Cambodge, Virology Unit, Phnom Penh, Cambodia
[b] National Veterinary Research Institute, Ministry of Agriculture Forestry and Fisheries, Cambodia
[c] Forest Administration, Ministry of Agriculture Forestry and Fisheries, Cambodia
[d] Wildlife Conservation Society, Cambodia

Showing 42 of 42 genomes sampled between Dec 2019 and Jan 2020.

Phylogeny

Article

A pneumonia outbreak associated with a new coronavirus of probable bat origin

What **do** we know?

- Across 25 high-risk viral families, there are estimated to be **1.7M unknown viruses**
- About **700k of which** likely have the potential to infect humans
- For example, for every known coronavirus, there are thousands of unknown coronaviruses circulating in wildlife

Carroll et al. (2018) Science

POLICY FORUM

INFECTIOUS DISEASES

The Global Virome Project

Expanded viral discovery can improve mitigation

By **Dennis Carroll, Peter Daszak, Nathan D. Wolfe, George F. Gao, Carlos M. Morel, Subhash Morzaria, Ariel Pablos-Méndez, Oyewale Tomori, Jonna A. K. Mazet**

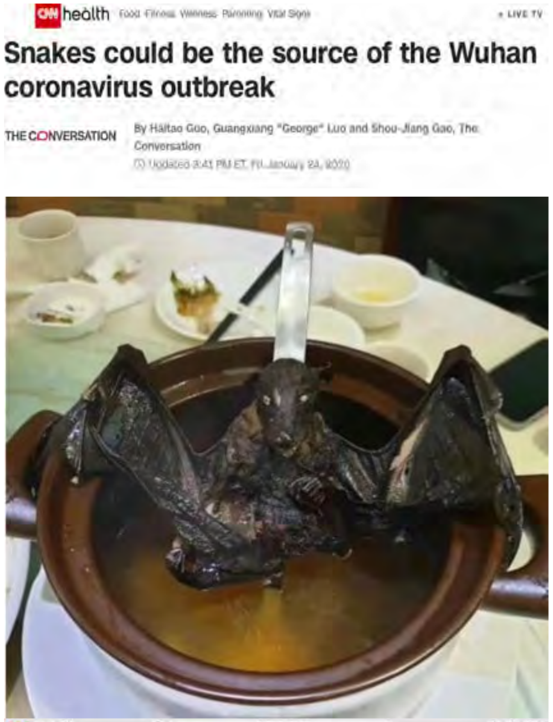
causing the next great pandemic (*1*, *2*). However, if these viruses are our enemy, we do not yet know our enemy very well. Around 263 viruses from 25 viral families are known to infect humans (*3*) (see the figure), and given

Scientists prepare to collect a blood sample from a *Rousettus sp.* fruit bat in Thailand to test for novel viruses. The Global Virome Project aims to identify and characterize the majority of currently unknown viruses in key wildlife groups, including rodents, nonhuman primates, and bats.

Other previous studies had begun to conduct targeted viral discovery in wildlife (*9*), and develop mitigation strategies for the emergence of avian flu, for example. However, the USAID Emerging Pandemic Threats (EPT) PREDICT project is the first global-scale coordinated program designed to conduct viral discovery in wildlife reservoir hosts, and characterize ecological and socioeconomic factors that drive their risk of spillover, to mitigate their emergence in people (*10*).

Working with local partners and governments, wildlife and domestic animals and at-risk human populations in geographic hotspots of disease emergence (*1*) are sampled, and viral discovery conducted. A strategy to identify which novel viruses are most at risk of spillover has been developed (*11*), and further work is conducted on these to characterize them prior to, or in the early stages of, spillover. Metadata on the ecology of wildlife–livestock–human transmission interfaces, and on human behavioral patterns in communities, are concurrently analyzed so that strategies to reduce spillover can be developed (supplementary text). To date,

What **do we not** know?



Snakes could be the source of the Wuhan coronavirus outbreak

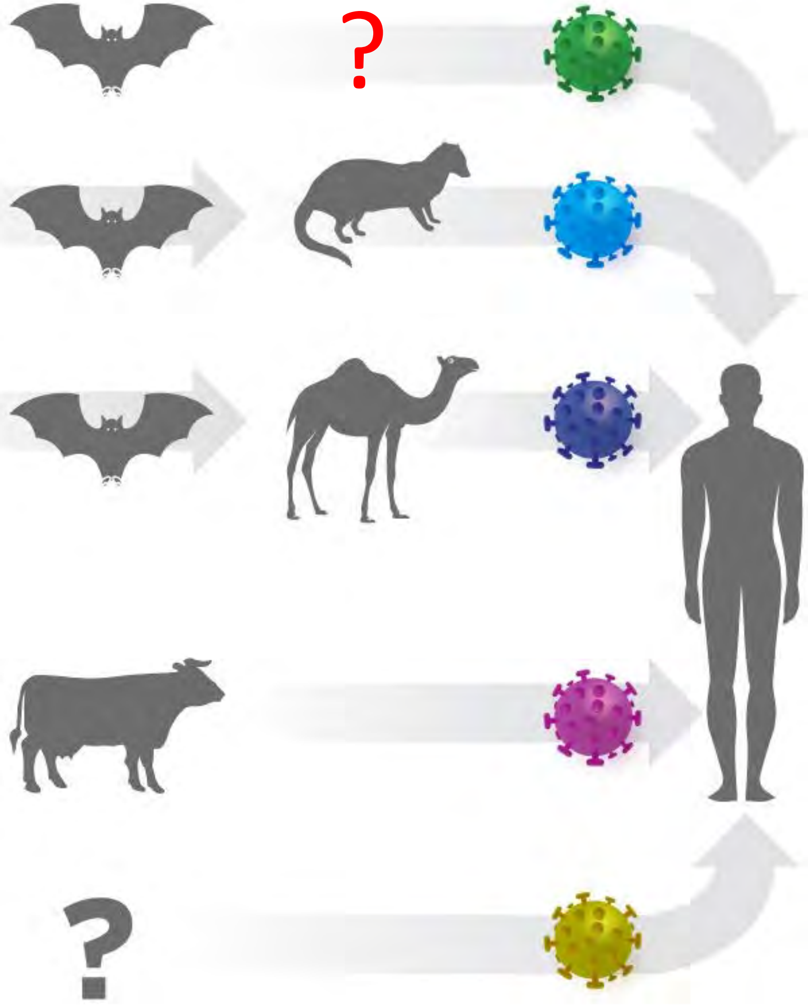
By Haitao Guo, Guangxiang "George" Luo and Shou-Jiang Gao, The Conversation

Updated 3:41 PM ET, Fri January 24, 2020

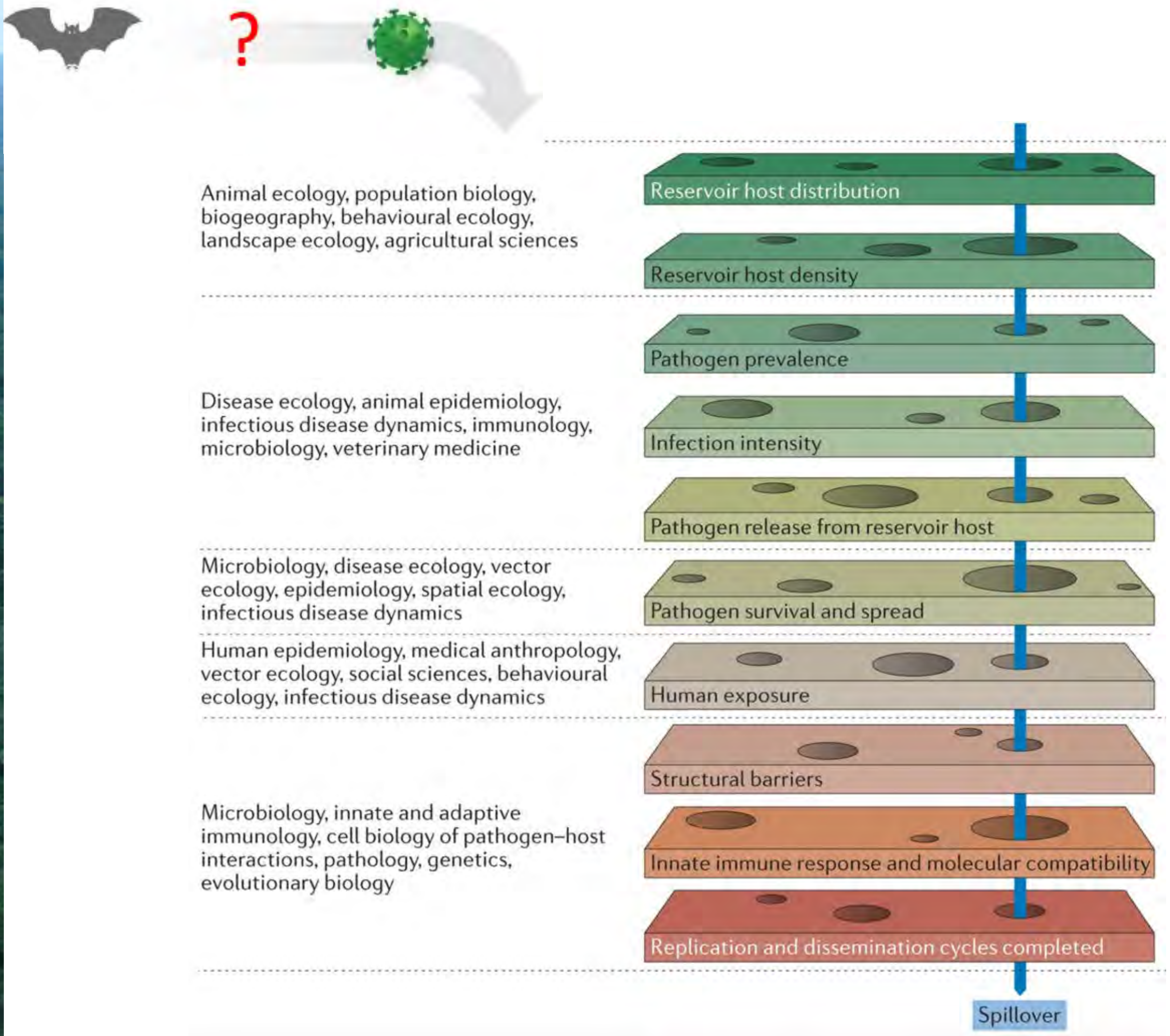
Coronavirus from Space?

A heterodox communication from Chandra Wickramasinghe to the Lancet

February 4, 2020 0 Comments



It is not about bat-soup, civets or pangolins



Animal ecology, population biology, biogeography, behavioural ecology, landscape ecology, agricultural sciences

Disease ecology, animal epidemiology, infectious disease dynamics, immunology, microbiology, veterinary medicine

Microbiology, disease ecology, vector ecology, epidemiology, spatial ecology, infectious disease dynamics

Human epidemiology, medical anthropology, vector ecology, social sciences, behavioural ecology, infectious disease dynamics

Microbiology, innate and adaptive immunology, cell biology of pathogen–host interactions, pathology, genetics, evolutionary biology

Barriers to spillover. This figure was adapted from Plowright et al. 2017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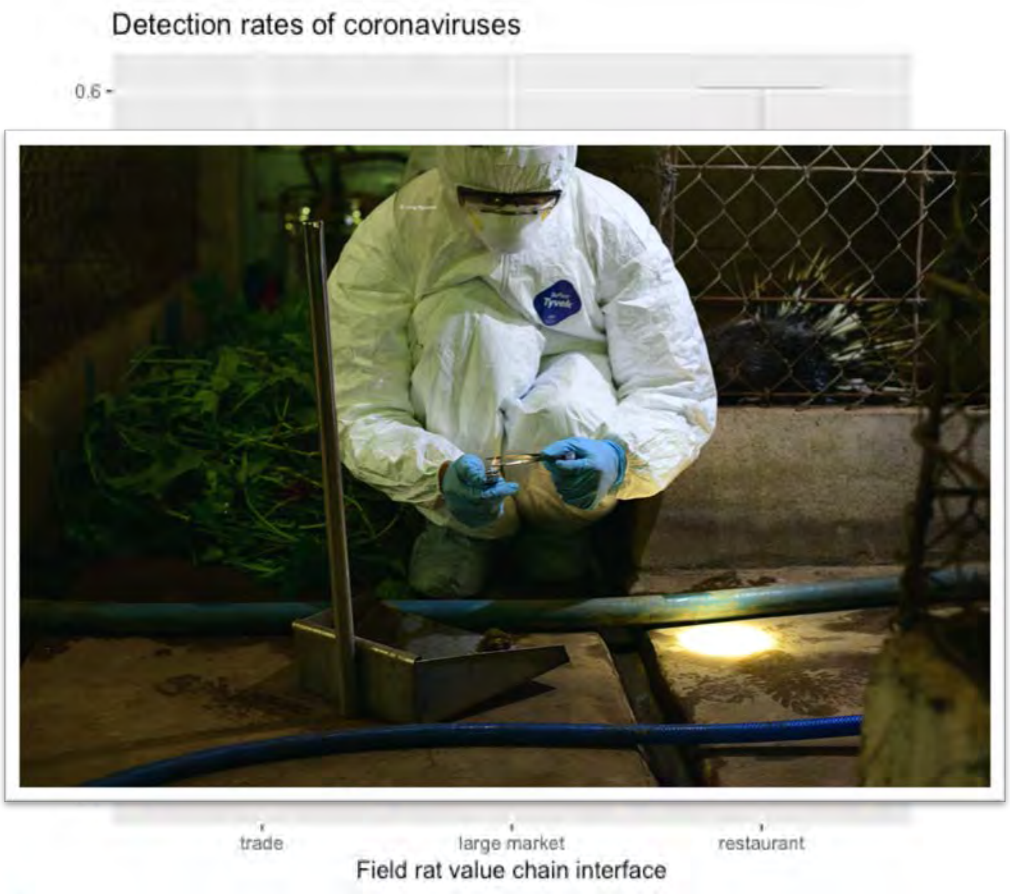
大:$3 /盒
特級四寶丸
$28/盒
龍蝦包心丸
$22/盒
$45/磅
羊肉片
每磅 $65
每磅 $65
$36/磅
$58/磅
推介
$80/磅
蝦滑
墨魚滑
牛柏葉 $30
手包水餃
手包雲吞
$35/盒
迷你菜肉餃
$15盒


What **do** we know?



- What **do we not** know?

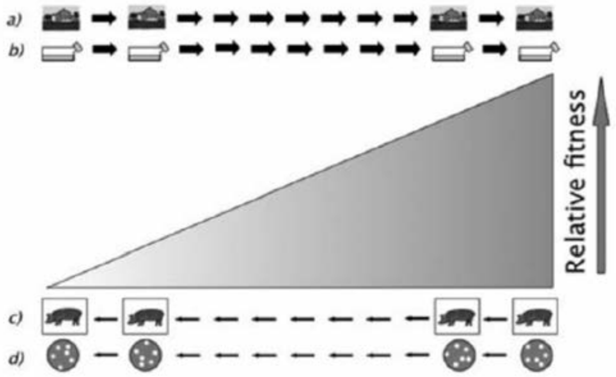


Fig. 1
A simplified schematic of fitness variation of a virus following replication in a constant environment

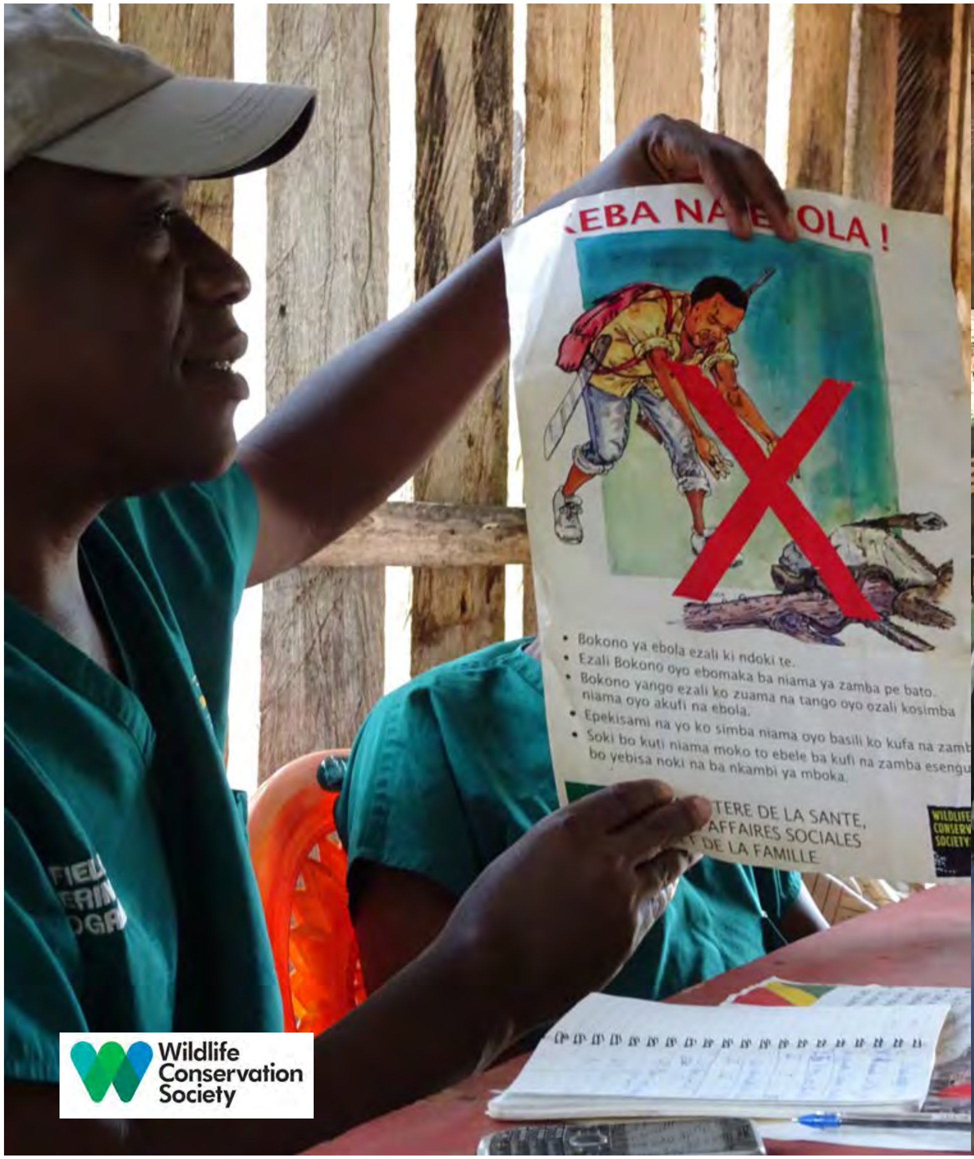
Drew et al 2011. Rev Scien Tech OIE

Photo/Xinhua

IPLC - Congo Basin

- Long-standing program
    - Carcass monitoring [Ebola virus community engagement targeted 6,600 people living in northern RoC]
    - Community outreach IPLC needs and rights

Wildlife Conservation Society



Wildlife Conservation Society

World Health Organization

INTERNATIONAL FEDERATION


Start Run
Data Management
Protocol Management
Wildlife
Conservation
Society

One Health History

- 2004 **One World, One Health** meetings with human public health, conservation and infectious disease experts were organized by WCS
  - **Manhattan Principles**
- **Berlin Principles 2019**

2019 Berlin Principles on One Health

- Recognize and take action to: retain the essential health links between humans, wildlife, domesticated animals and plants, and all nature; and ensure the conservation and protection of biodiversity which, interwoven with intact and functional ecosystems, provides the critical foundational infrastructure of life, health, and well-being on our planet

Ostfeld et al. 2002 Mazet et al. JVME 33 2006

www.wcs.org/one-planet-one-health-one-future

What do we need to do?

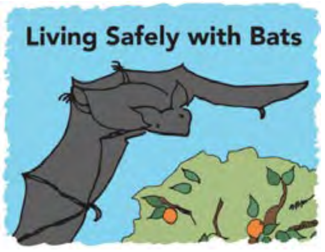
- Permanently ban the commercial trade in wildlife for consumption
- Strengthen efforts to combat trafficking of wild animals within countries and across borders
- Work to change dangerous wildlife consumption behaviors, especially in cities
- Mainstream holistic One Health Approaches

WCS ISSUES POLICY ON REDUCING RISK OF FUTURE ZOONOTIC PANDEMICS

MARCH 28, 2020

A NEW PARADIGM URGENTLY NEEDED:

To prevent future major viral outbreaks such as the COVID-19 outbreak, impacting human health, well-being, economies, and security on a global scale, WCS recommends stopping all commercial trade in wildlife for human consumption (particularly of birds and mammals) and



We Stand for Wildlife™

WCS

Reducing the Demand for and Trade in Wildlife Products – The View from South-East Asia

K. Yoganand

Regional Lead for Wildlife and Wildlife Crime

WWF Greater Mekong

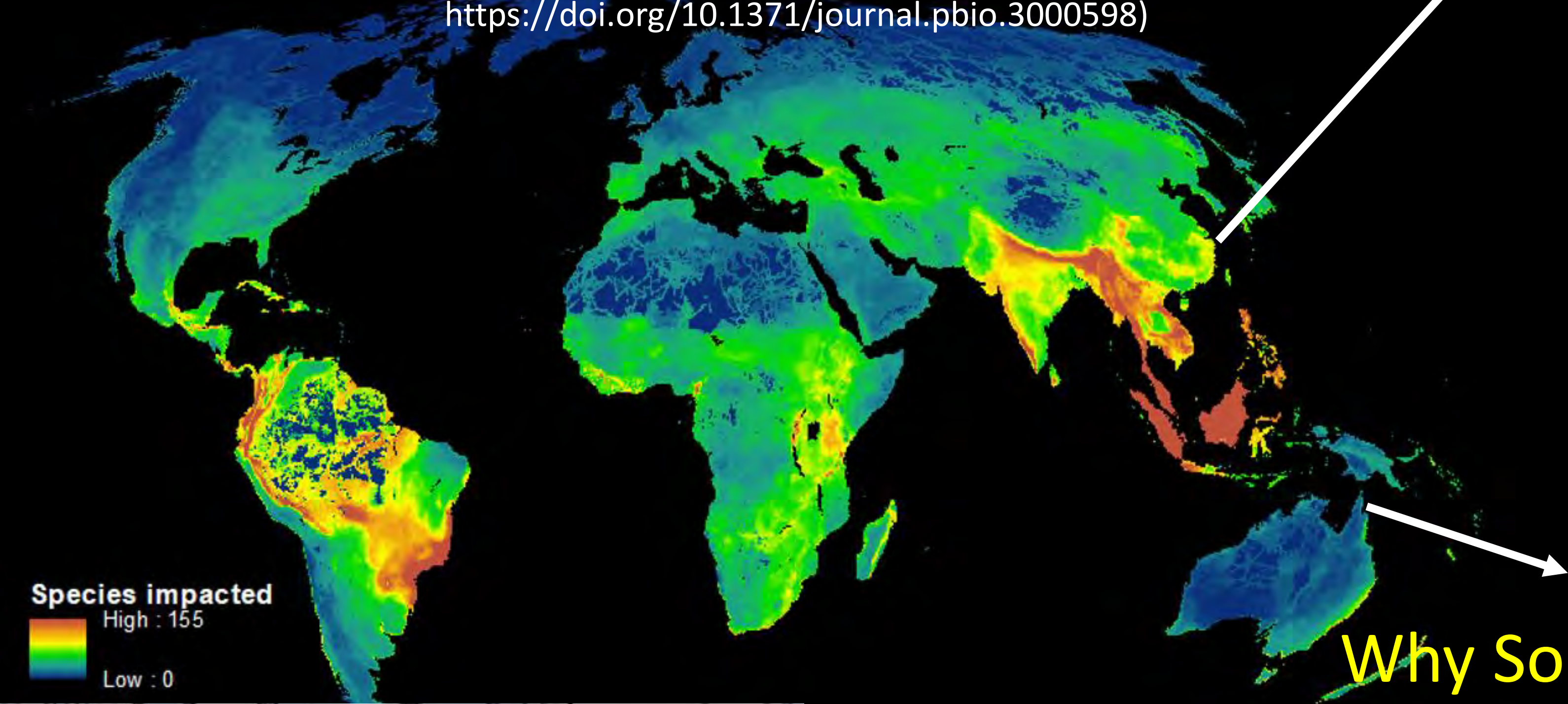
Outline

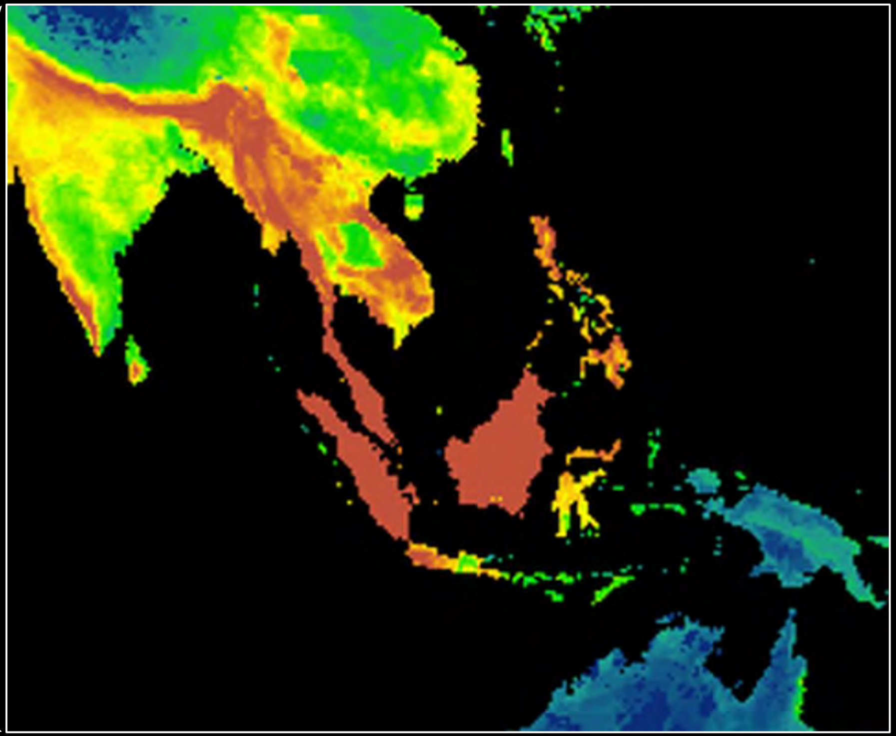
- Key ideas
- Wildlife trade →
  - ➢Declines/extinctions
  - ➢Infectious disease (spillover) risks
- Consumer demand

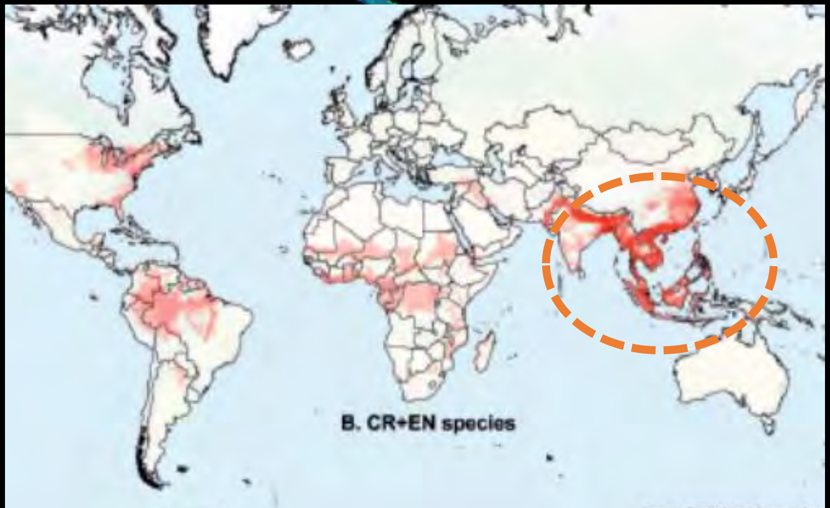
WWF/Bas Huijbregts

Hotspots of human impact on threatened vertebrates

(Map credit: Allan, Watson et al. Plos Biol, 17(12): e3000598
https://doi.org/10.1371/journal.pbio.3000598)







Why South-East Asia?

- Historical species diversity – high
- Population extinctions – >90% ?
- Defaunated landscapes - widespread
- Empty forests - common
- Indiscriminate snaring – crisis

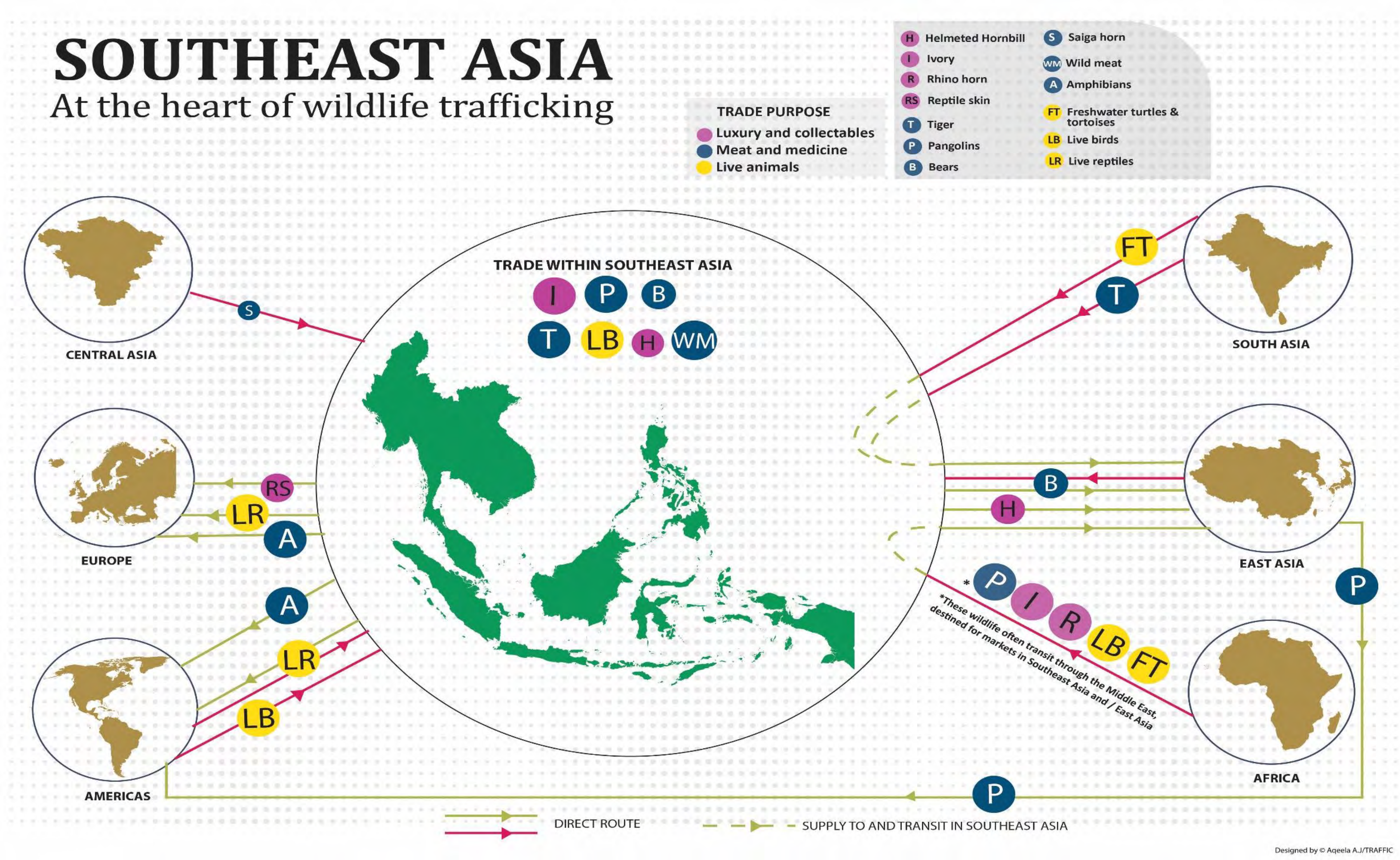
Why South-East Asia?

- Trade hotspot, trafficking route
- Largest wildlife market, together with East Asia
- ⬆ human population
- ⬆ disposal income

International Trafficking Routes For Pangolins

SOURCE: NEPALI TIMES

The Pangolin Reports
www.pangolinreports.com



(Map: Krishnasamy, K. and Zavagli, M. (2020). *Southeast Asia: At the heart of wildlife trade*. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia)

How large is the wildlife trade / market?

(not including timber and fisheries)

Speculative estimates – reliable data is limited

Region	Illegal trade (in billion USD)	Legal trade (in billion USD)
Southeast Asia	1 – 2 /year	3 – 10 /year
East Asia	5 – 10 /year	50 – 100 /year
Global total (including domestic legal trade)	7 – 23 /year (2007 estimate)	150 – 200 /year (15 bn in international trade the early 1990s)

This involves 100s of millions of wild animals, 1000s of species every year (million+ live primates)

J. Bouhuys/TRAFFIC

What drives the trade?

- Consumer demand
  - Live wildlife – for caged/captive display (“pets”)
  - Wildlife meat – local communities and urban consumers
  - Parts and products for traditional medicine
  - For biomedical research – often international
  - Clothing and fashion (fur, ornaments) – global supply
- Profiteering
- Corruption
- Up to 10 % of the population in SE Asia may be consumers (tbc)

@WWF-Myanmar

Irrawaddy Elephant Lover

Laws on wildlife trade and consumption

- Mostly based on species status, population trends
  - often based on outdated or unreliable data
- No international or national protection for many species
- Regulate import, possession, trade, and hunting, but not eating
- Laws regulate wildlife farming, but often weak on enforcement
- Laws rarely consider infectious disease risks of species/taxa


Panha Makara WWF Cambodia

Law enforcement on illegal wildlife trade

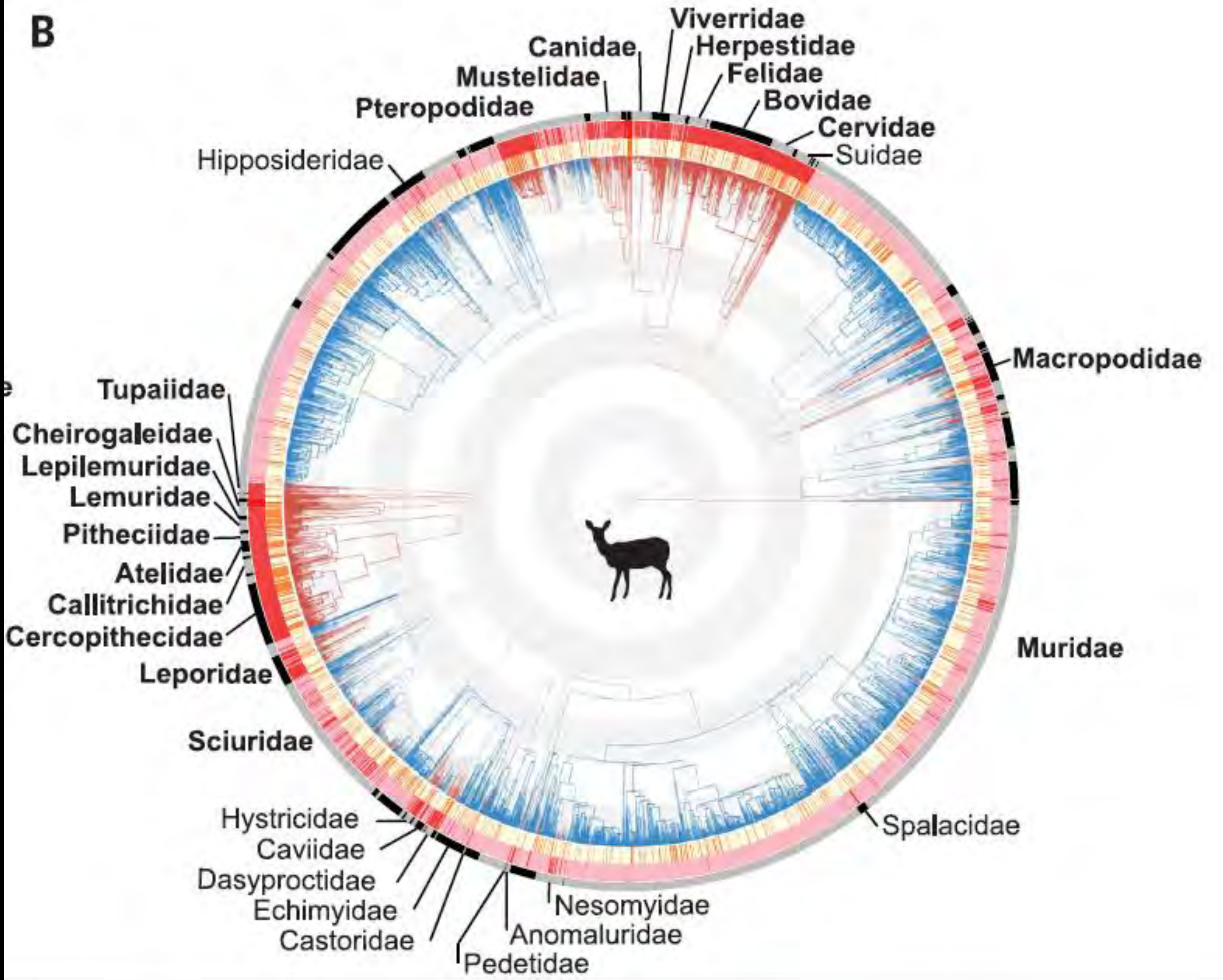
- Weak law enforcement
- Legal trade weakly regulated
- Legal trade confuses and strains law enforcement
- Uncontrolled wild sourcing
- Laundering through farms
- Corruption and fraud
- Illegal trade thrives

Mia Signs/WWF Greater Mekong

High-risk taxa

- Prohibit trade and consumption of high-risk taxa
  - for food and traditional medicine
- High-risk taxa
  - viral pathogen transmission risk to humans
  - Provisionally include all mammals and birds
  - Assess all mammal and bird species for risks
  - Particularly high-risk are bats, primates, rodents, carnivores

Mammalian taxa globally traded, often legally
(sourced from CITES database)



(From: Scheffers et al (2019), Science, 366, 71-76)

High-risk wildlife trade, farms & markets

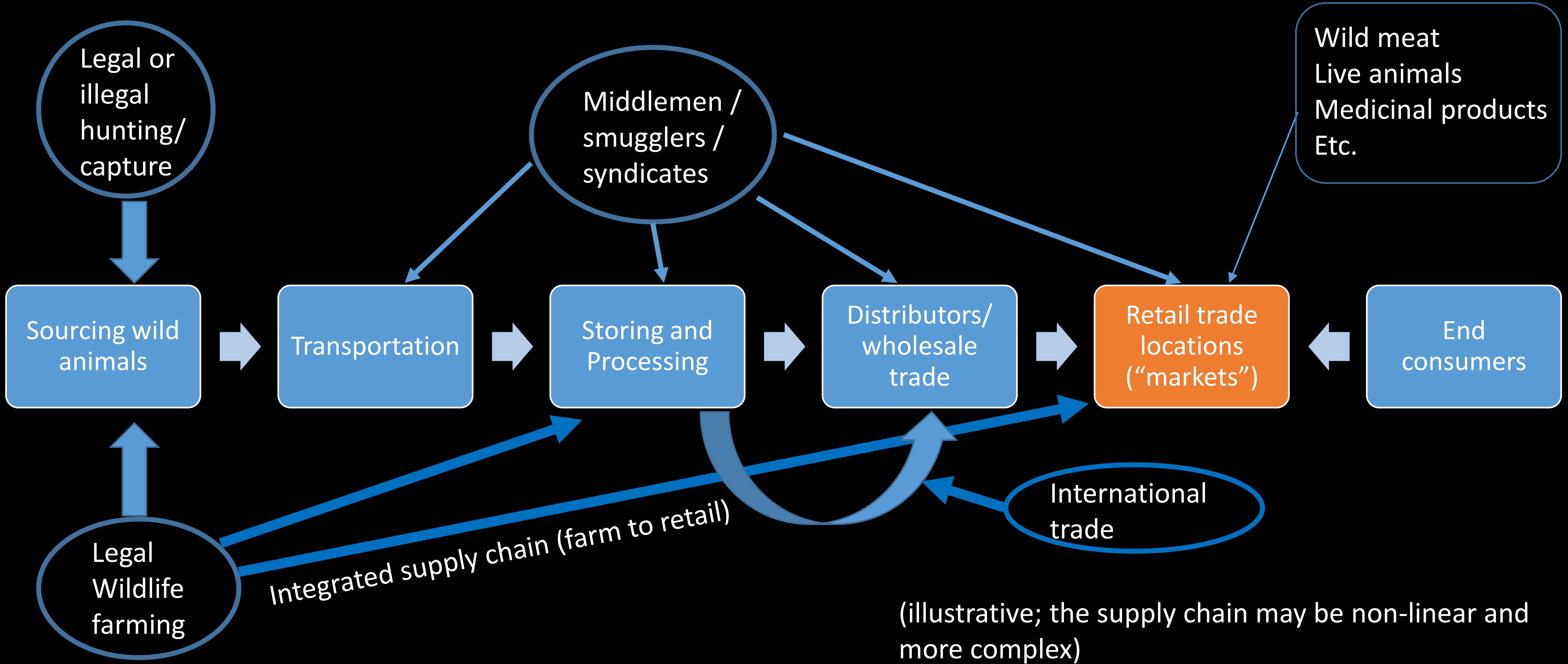
High-risk market:

- Large volumes of trade
- High human visitation rates
- Live animal, wild meat trade
- Wet markets, highway stalls, tourist centres, wild meat restaurants and farms
- Legal vs illegal – viral disease risk same
  - Legal trade is far larger than illegal trade


WWF

Wildlife trade supply chain –

Risks of spillover at every stage (irrespective of legality)



Legal or illegal hunting/ capture

Middlemen / smugglers / syndicates

Wild meat
Live animals
Medicinal products
Etc.

Sourcing wild animals

Transportation

Storing and Processing

Distributors/ wholesale trade

Retail trade locations (“markets”)

End consumers

International trade

Legal Wildlife farming

Integrated supply chain (farm to retail)

(illustrative; the supply chain may be non-linear and more complex)

Reducing consumer demand

- Identify consumers and motivations for demand
- Target urban consumers for wild meat
- Other consumer segments for medicinal products
- Conduct public outreach on disease risks of wildlife consumption
- Legal bans and ban awareness very effective in reducing demand

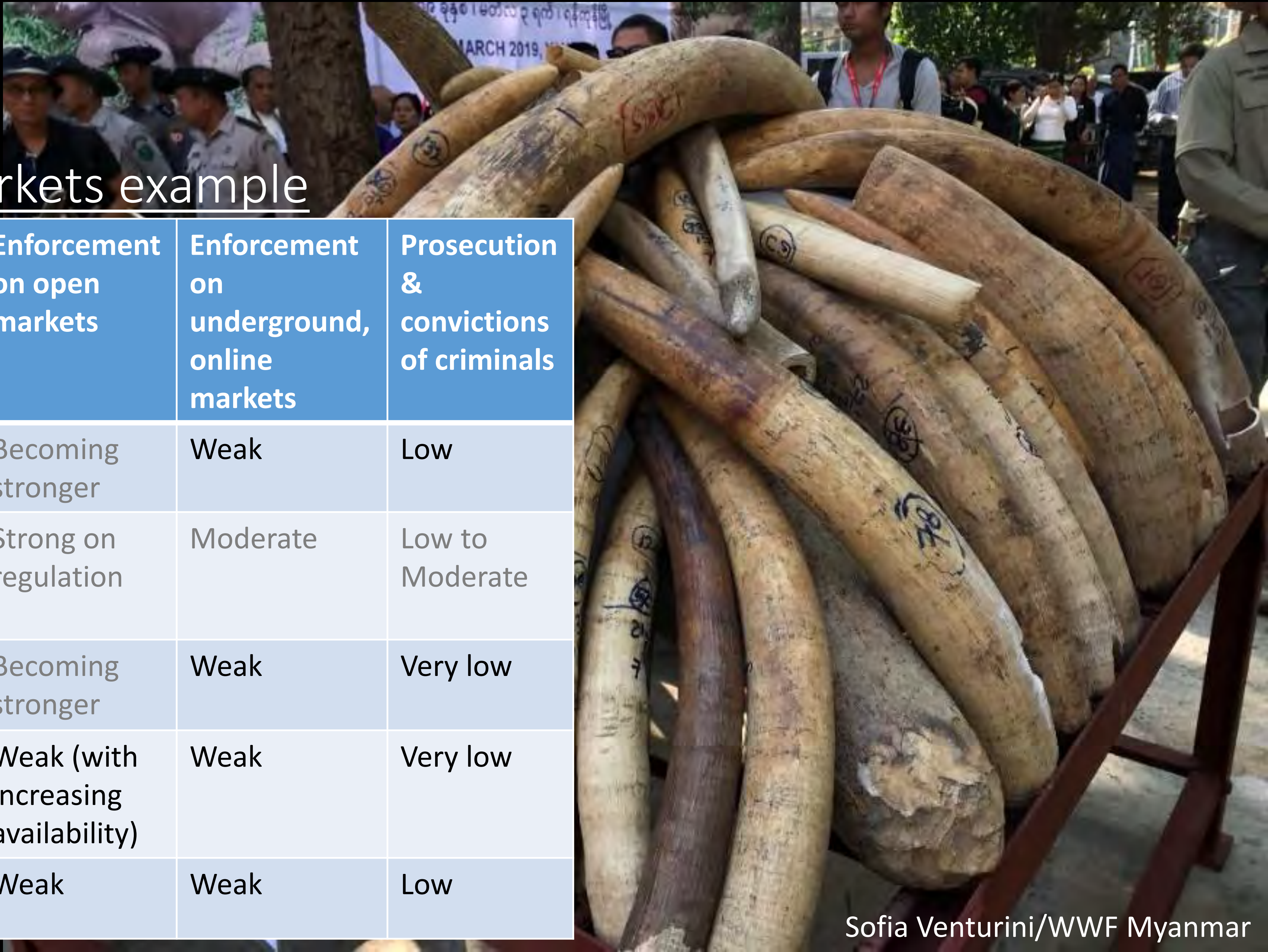
Policy and enforcement opportunities

- China example of prohibiting trade and consumption of certain taxa for food
- Vietnam made a start but now unknown?
- Immediate prohibition through Prime Minister Orders, followed by changes to law
- Fix policy gaps and weaknesses on other aspects of wildlife trade
- Post-COVID-19 recovery should include increased resources for law enforcement
  - On illegal trade
  - For protection in natural habitats


WWF Laos

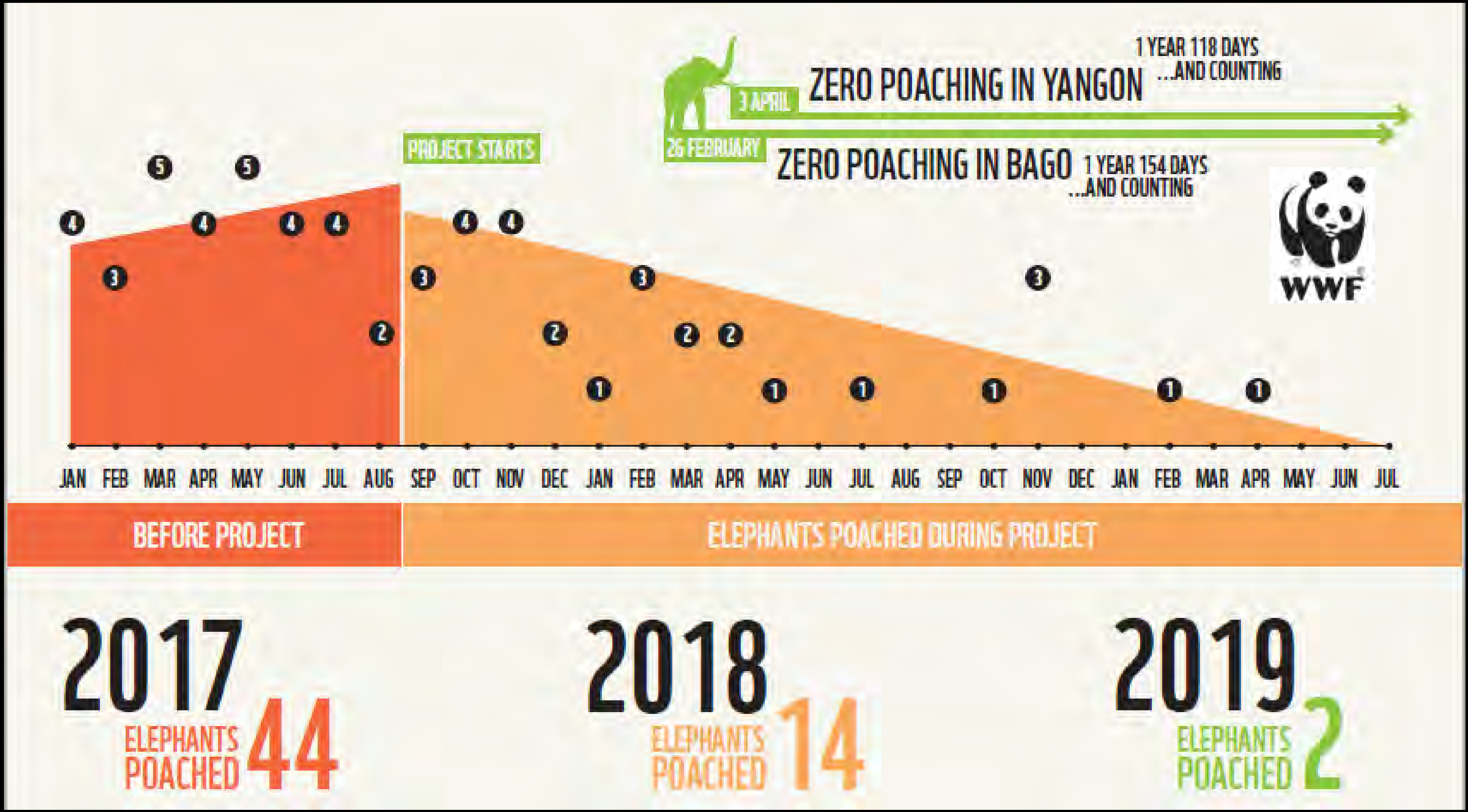
Elephant ivory markets example

Countries	Legal status of ivory markets	Enforcement on open markets	Enforcement on underground, online markets	Prosecution & convictions of criminals
Myanmar	Closed	Becoming stronger	Weak	Low
Thailand	Partially open, regulated	Strong on regulation	Moderate	Low to Moderate
Laos	Closed	Becoming stronger	Weak	Very low
Cambodia	Closed	Weak (with increasing availability)	Weak	Very low
Vietnam	Closed	Weak	Weak	Low



Sofia Venturini/WWF Myanmar

Stop the supply – WWF’s Zero-poaching work in Myanmar



WWF Laos

Thank you!