Surveillance Of Wildlife Trade For Risk Of Future Zoonotic Disease Outbreaks

Eric Wikramanayake
Asia-Pacific Counter-Illegal Wildlife Trade Hub. WWF Hong Kong

- Deforestation, forest degradation and human incursions into forests increase human-wildlife contact
- Wildlife caught and killed for consumption, including trade and trafficking
- Some wildlife known to carry high viral loads, including with zoonotic potential
- Essential to monitor and regulate wildlife trade and transport situations to prevent epidemics and pandemics

- Approximately 3-4 new infectious diseases emerge each year
- Majority are zoonotic
- Originate from wildlife

SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. hCoV-EMC=human coronavirus Erasmus Medical Center. 2019-nCoV=2019 novel coronavirus. HARS-CoV=Han acute respiratory syndrome coronavirus. For 2019-nCoV, data are for Feb 9, 2020. *Although the 2014 Ebola outbreak was believed to start with a direct bat-to-human transmission, non-human primates have been indicated in previous Ebola outbreaks.

	Year of first major outbreak	Countries or regions affected	Bat origin status	Main intermediate animal host responsible for human infection
Hendra	1994	Australia	Confirmed	 Horses
Nipah	1998-99	Malaysia and 4 other countries	Confirmed	 Pigs
SARS	2002-03	China and 25 other countries	Confirmed	 Civet
MERS	2012	Saudi Arabia and 26 other countries	Suspected	 Camels
Ebola	2014	Guinea and 6 other countries	Highly suspected	Non-applicable*
2019-nCoV	2019-20	212 countries, as of April 30, 2020	Suspected	Presently unknown

Summary characteristics of major outbreaks for zoonotic EIDs in the past 25 years (from Wang et al. 2020)

- Climate change expected to increase incidents as people, wildlife, and vectors begin to move and shift.

Climate change increases cross-species viral transmission risk

https://doi.org/10.1038/s41586-022-04788-w
Received: 24 January 2020
Accepted: 21 April 2022
Published online: 28 April 2022
Check for updates

Colin J. Carlson[1,2,7], Gregory F. Albery[1,3,7], Cory Merow[4], Christopher H. Trisos[5], Casey M. Zipfel[1], Evan A. Eskew[3,6], Kevin J. Olival[3], Noam Ross[3] & Shweta Bansal[1]

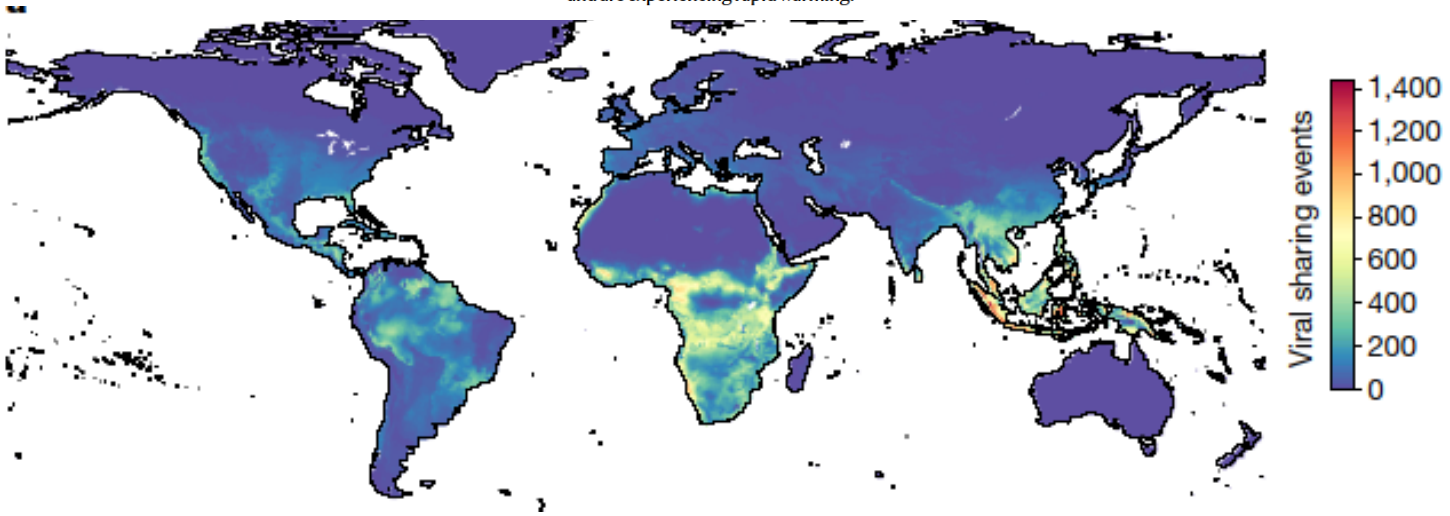
At least 10,000 virus species have the ability to infect humans but, at present, the vast majority are circulating silently in wild mammals[1,2]. However, changes in climate and land use will lead to opportunities for viral sharing among previously geographically isolated species of wildlife[3,4]. In some cases, this will facilitate zoonotic spillover—a mechanistic link between global environmental change and disease emergence. Here we simulate potential hotspots of future viral sharing, using a phylogeographical model of the mammal–virus network, and projections of geographical range shifts for 3,139 mammal species under climate-change and land-use scenarios for the year 2070. We predict that species will aggregate in new combinations at high elevations, in biodiversity hotspots, and in areas of high human population density in Asia and Africa, causing the cross-species transmission of their associated viruses an estimated 4,000 times. Owing to their unique dispersal ability, bats account for the majority of novel viral sharing and are likely to share viruses along evolutionary pathways that will facilitate future emergence in humans. Notably, we find that this ecological transition may already be underway, and holding warming under 2 °C within the twenty-first century will not reduce future viral sharing. Our findings highlight an urgent need to pair viral surveillance and discovery efforts with biodiversity surveys tracking the range shifts of species, especially in tropical regions that contain the most zoonoses and are experiencing rapid warming.

Climate change

Heating and stirring the global viral soup

Rachel E. Baker & C. Jessica E. Metcalf

Simulations show that rising global temperatures and changes in land use will drive new encounters between mammalian species. This could lead to an increase in virus-sharing events that might threaten both wildlife and humans. See p.555



The projected number of novel viral sharing events among mammal species in 2070 based on geographical range shifts of the 3139 host species from changes in climate and land use.

Rapid assessment tool to monitor markets for high-disease risk wildlife

- With Covid 19 pandemic, WWF's AP Counter-Illegal Wildlife Trade Hub developed this to monitor and regulate wildlife trade

One Health 13 (2021) 100279

Contents lists available at ScienceDirect

One Health

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

A tool for rapid assessment of wildlife markets in the Asia-Pacific Region for risk of future zoonotic disease outbreaks

Eric Wikramanayake [a,*], Dirk U. Pfeiffer [b], Ioannis Magouras [b], Anne Conan [b], Stefan Ziegler [c], Timothy C. Bonebrake [d], David Olson [a]

[a] WWF Asia-Pacific Counter-Illegal Wildlife Trade Hub (IWT Hub), WWF-Hong Kong, Kwai Chung, New Territories, Hong Kong SAR, PR China
[b] Centre for Applied One Health Research and Policy Advice, City University of Hong Kong, Kowloon, Hong Kong SAR, PR China
[c] WWF-Germany, Taunusanlage 8, 60329 Frankfurt/Main, Germany
[d] Division for Ecology & Biodiversity, School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, PR China

ARTICLE INFO

Keywords:
Asia-Pacific
Ecology
OneHealth
Pandemic
Wildlife trade
Zoonoses

ABSTRACT

Decades of warnings that the trade and consumption of wildlife could result in serious zoonotic pandemics have gone largely unheeded. Now the world is ravaged by COVID-19, with tremendous loss of life, economic and societal disruption, and dire predictions of more destructive and frequent pandemics. There are now calls to tightly regulate and even enact complete wildlife trade bans, while others call for more nuanced approaches since many rural communities rely on wildlife for sustenance. Given pressures from political and societal drivers and resource limitations to enforcing bans, increased regulation is a more likely outcome rather than broad bans. But imposition of tight regulations will require monitoring and assessing trade situations for zoonotic risks. We present a tool for relevant stakeholders, including government authorities in the public health and wildlife sectors, to assess wildlife trade situations for risks of potentially serious zoonoses in order to inform policies to tightly regulate and control the trade, much of which is illegal in most countries. The tool is based on available knowledge of different wildlife taxa traded in the Asia-Pacific Region and known to carry highly virulent and transmissible viruses combined with relative risks associated with different broad categories of market types and trade chains.

1. Introduction

A growing body of evidence linking wildlife trade and consumption to zoonotic events has prompted conservationists, epidemiologists, and virologists to issue warnings of zoonotic disease outbreaks with pandemic potential if such practices are not halted [1–11]. These warnings have gone largely unheeded. Now, with the COVID-19 pandemic adversely affecting every country in the world, there are renewed calls for urgent controls and even outright bans of the wildlife trade [8,12]. China, arguably the biggest wildlife consuming and trading nation, imposed a broad ban on wildlife trade and markets [13]. However, there is also opposition to wildlife trade bans from several quarters, citing restrictions on livelihood opportunities and reduced access to food for local communities who depend on wildlife, and concerns that trade will be driven underground [14–18].

While almost all wildlife trade has some level of zoonotic risks, some taxonomic groups (e.g., primates, bats, pangolins, civets, and rodents) are high-risk reservoirs of more virulent pathogens. Thus, the trade should be tightly regulated and monitored to prevent the sales of such high-risk species [4]. Particular types of wildlife markets and trade chains can also increase risk of disease transmission and spread based on: 1) the numbers and types of wildlife taxa being traded, especially the diversity of animals for sale; 2) interactions between wildlife, people, domestic, or peridomestic species; 3) length of prior and posterior trade chains; 4) connectedness of the market within the network of markets; 5) stressors on animals in markets; and 6) movement patterns of buyers and traders beyond points of sale [19]. Because even rare zoonotic events associated with the wildlife trade can have catastrophic socio-economic consequences, strategic wildlife trade prohibitions are important to reduce the probability of future trade-related pandemics. But given the opposition to wildlife trade bans, it is more likely that more nuanced approaches will emerge that balance market risk levels with subsistence hunting and use of wildlife by rural people [20,21].

We present a tool (Appendix A) to assess wildlife markets in the Asia-

* Corresponding author.
E-mail address: ericw@wwf.org.hk (E. Wikramanayake).

https://doi.org/10.1016/j.onehlt.2021.100279
Received 20 March 2021; Received in revised form 11 June 2021; Accepted 15 June 2021

https://doi.org/10.1016/j.onehlt.2021.100279

Transparent algorithm to assess:

1. 11 general market types for
   - Transmission Risk
   - Spread Potential
   - Zoonotic Virus Risk
2. Species and numbers of high disease-risk species for sale in markets

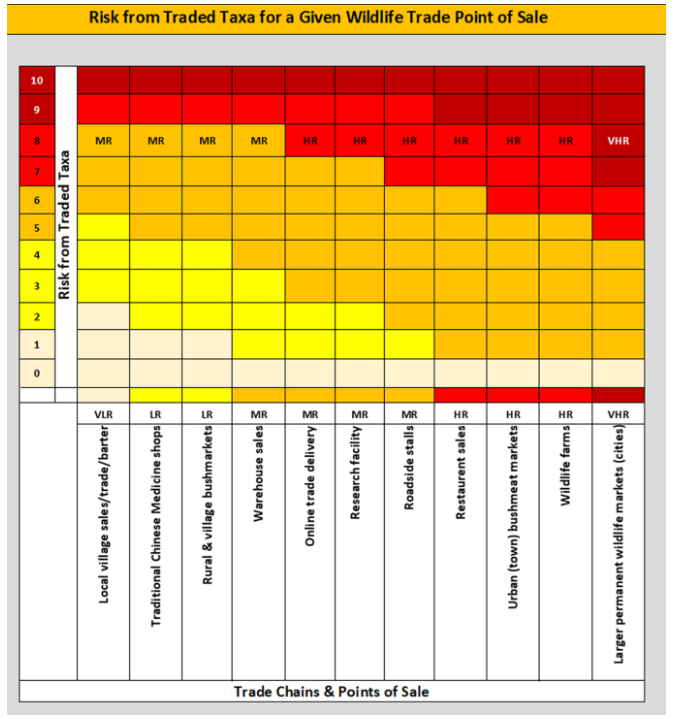
- Market variables classify zoonoses risks based on market size, crowding of wildlife to create stressful situations, hygiene conditions, number and turnover of people through the market, distance buyers may travel after visiting a market, and points along market trade chains that could allow viruses to accumulate and amplify the potential for zoonoses.

Taxonomic Risk categories of key faunal groups. Criteria for categorizations and references are provided in Supplementary Material Appendix A.

Taxonomic Group	Taxonomic Risk Category
Primates-Great Apes (Orangutan, Gibbons)	High
Pteropodidae - fruit bats/flying foxes	High
Rhinolophidae - horseshoe bats	High
Sciurognathi - mice, rats, hamsters, jerboas, voles, others	High
Manidae - pangolins	High
Viverridae - civets, mongooses	High
Primates - monkeys, macaque, loris, tarsier, other non-great ape	High
Wild birds - notably waterbirds	High
Mustelidae - weasels, otter, badgers, hog badgers, polecats, marten	High
Sciuridae - squirrels	Medium
Suidae - wild pigs, babirusa	Medium
Cervidae, Moschidae, Tragulidae other deer-like Artiodactyla	Medium
Felidae - wild cats	Medium
Canidae - wild dogs, jackals, foxes, wolves,	Medium
Perissodactyla - tapir, rhinoceros, asses, horses	Medium
Ailuridae - red panda	Medium
Ursidae - bears	Medium
Hystricidae - porcupines	Medium
Tupaidae - tree shrews	Low
Elephantidae	Low

General types of Asia-Pacific wildlife sale markets or points of sale.

Description of Wildlife Trade Sale/Trade Chain Type	Generalized Type Name
Larger, permanent markets in cities (consumption, pets, parts) (locally wild caught, possibly transported over distance or international, or captive bred, alive and dead)	Permanent wildlife markets
Wildlife sales from restaurants	Restaurant sales
Wildlife sales retrieved from warehouse on demand	Warehouse sales
Wildlife sales from TCM stalls (usually dead, dried, frozen)	TCM stalls
Wildlife sales from online or offline ads – shipped or picked up or delivered	Online trade delivery
Roadside sale of recently caught wildlife	Roadside sales
Rural (village) bushmeat markets (locally-caught or transported within region – live, dead, smoked, regular markets)	Rural bushmeat markets
Urban (town) bushmeat markets (domestic markets, town markets, caught in region, shorter transport)	Urban (town) bushmeat markets
Research animal facilities	Research facility
Local village sales/trade/barter & one-off sale from vehicles/boats of freshly caught wildlife	Local village sales/ trade/barter
Wildlife farms	Wildlife farms



iNaturalist- based project to monitor wildlife trade.

- Users can take photographs of wildlife and parts for sale and upload them into iNaturalist.

- The geo-referenced photographs will be ‘flagged’ and linked to the markets

    - Create a virtual ring fence around known markets to continue to ‘capture’ pictures of wildlife for sale for regulation and reporting
    - Identify possible or emerging markets by flagging wildlife for trade/sale outside of known markets
    - Identify species of concern in the trade

iNaturalist as a tool to harness citizen science to monitor wildlife markets

Since COVID-19 and its variants spread across the planet, a global spotlight on zoonotic diseases has highlighted the dangers of wildlife consumption. Despite this, the trade in wildlife and parts for consumption continues. In Asia, much of the trade and consumption is driven by beliefs that these species have medicinal or therapeutic properties or because affordability brings social status. On the other end of the scale, bushmeat represents the primary source of protein for many communities.

In Asia, wildlife markets come in many forms; from ‘pet shops’ to large markets that deal with dead and live wildlife kept under highly stressful and largely unhygienic conditions to smaller ‘stalls’ and shops embedded within large ‘wet markets’, and even small roadside stalls that may or may not be permanent. These are all potential sources of spill over of zoonotic diseases and can contribute to the extirpation of many species through unsustainable and extensive sourcing.

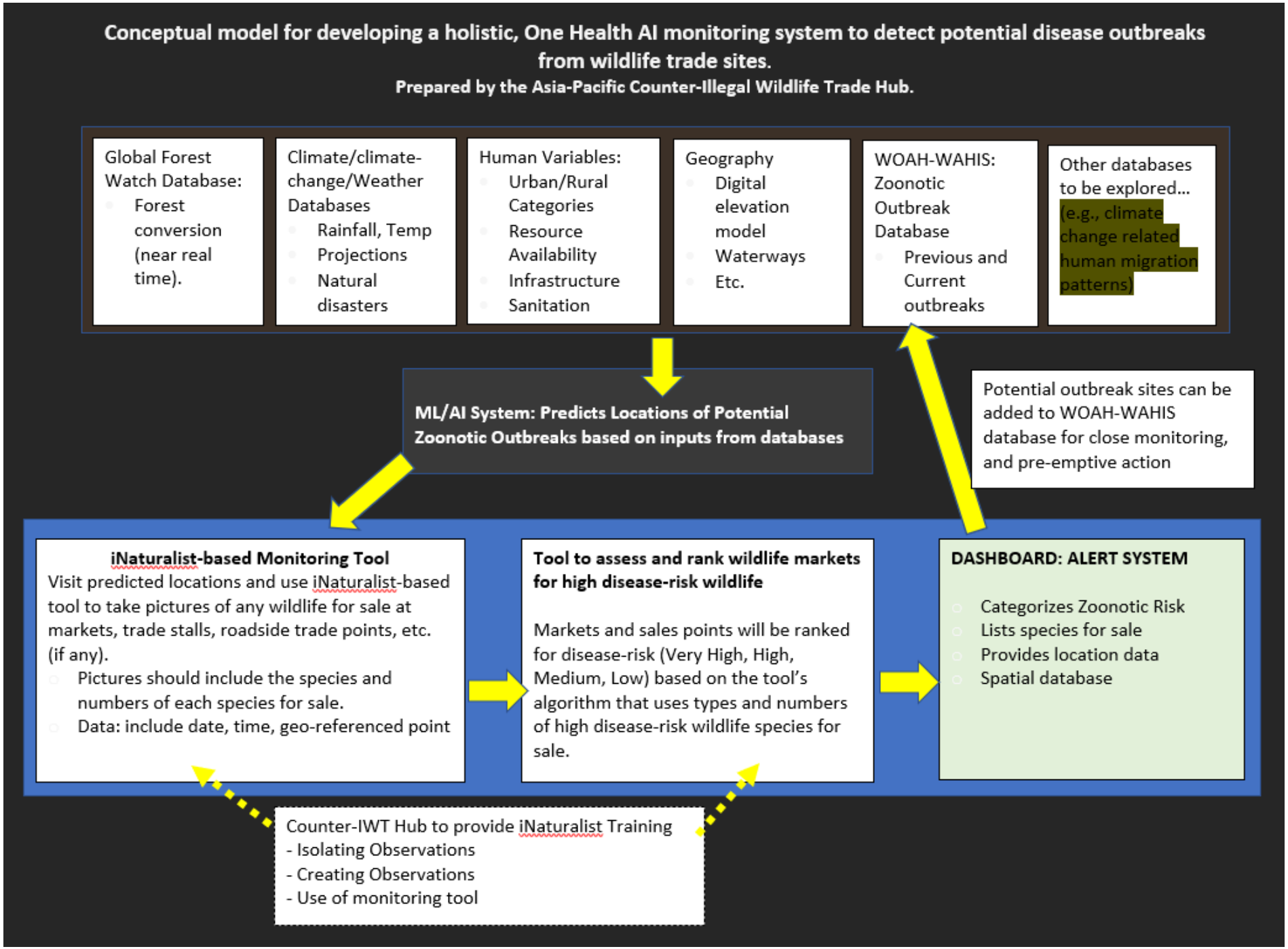
Recently, a Rapid Risk Assessment Tool (RRAT) was released for use in wildlife markets in the Asia-Pacific region. The tool, a risk matrix, helps authorities in public health and wildlife sectors assess markets and trade situations for zoonotic disease risk, based on the particular wildlife taxa available for sale and the kind of trade. However, the true number and location of these markets is not understood.

iNaturalist

iNaturalist is a widely used phone-based or website app, with a following of over a million users. It is a joint initiative by the California Academy of Sciences and the National Geographic Society. The app allows users to take geo-referenced photographs of wild animals and plants that are submitted to a central database where experts and enthusiasts offer identifications.

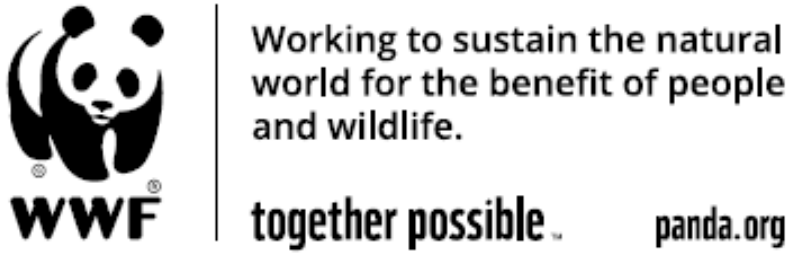
iNaturalist

- Ambition
- Bringing it all together with AI



Thank you!

A healthy planet is the foundation of our own health and well-being.



Eric D. WIKRAMANAYAKE, PhD
Director, WWF-Hong Kong
ericw@wwf.org.hk