



Photo © Julie Larsen Maher/WCS

How does biodiversity loss and environmental degradation increase the emergence of infectious diseases?

Dr. Stacy Jupiter, WCS Melanesia Regional Director



Links between ecological integrity, emerging infectious diseases originating from wildlife, and other aspects of human health - an overview of the literature

Tom Evans, Sarah Olson, James Watson, Kim Gruetzmacher, Mathieu Pruvot, Stacy Jupiter, Stephanie Wang, Tom Clements and Katie Jung



April 2020



Overview

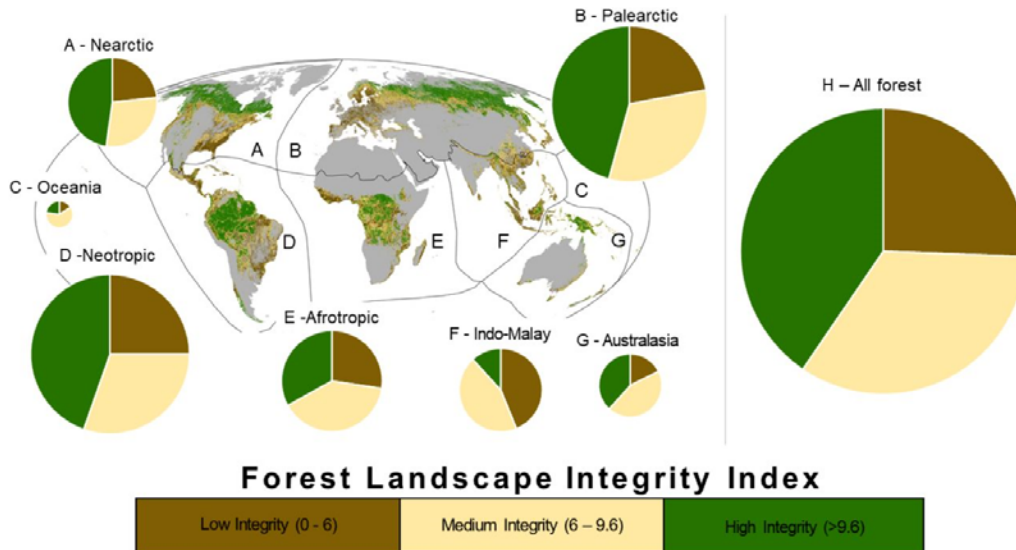
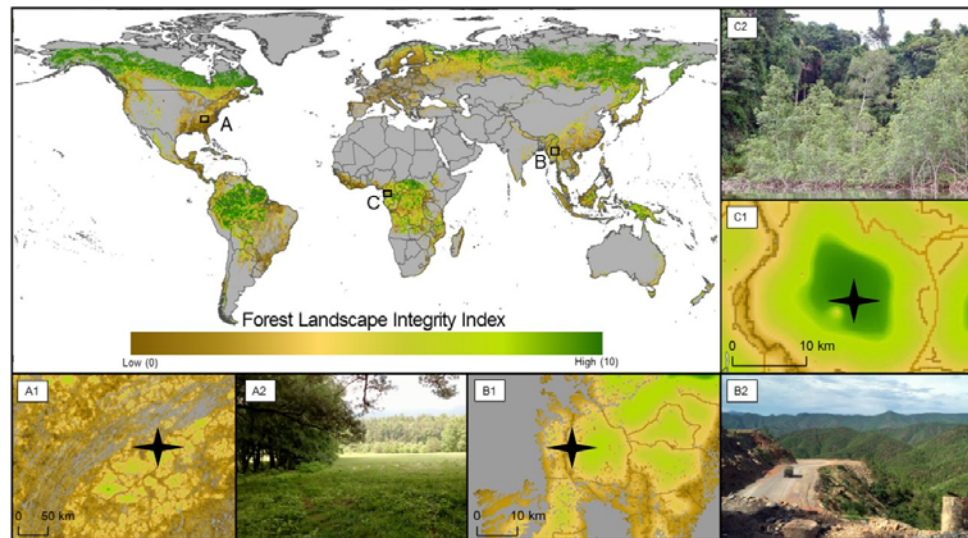
- Review of evidence

<https://www.wcs.org/get-involved/updates/a-primer-on-the-coronavirus>

- WISH Fiji: Model for management in practice



<https://wishfiji.sydney.edu.au/>



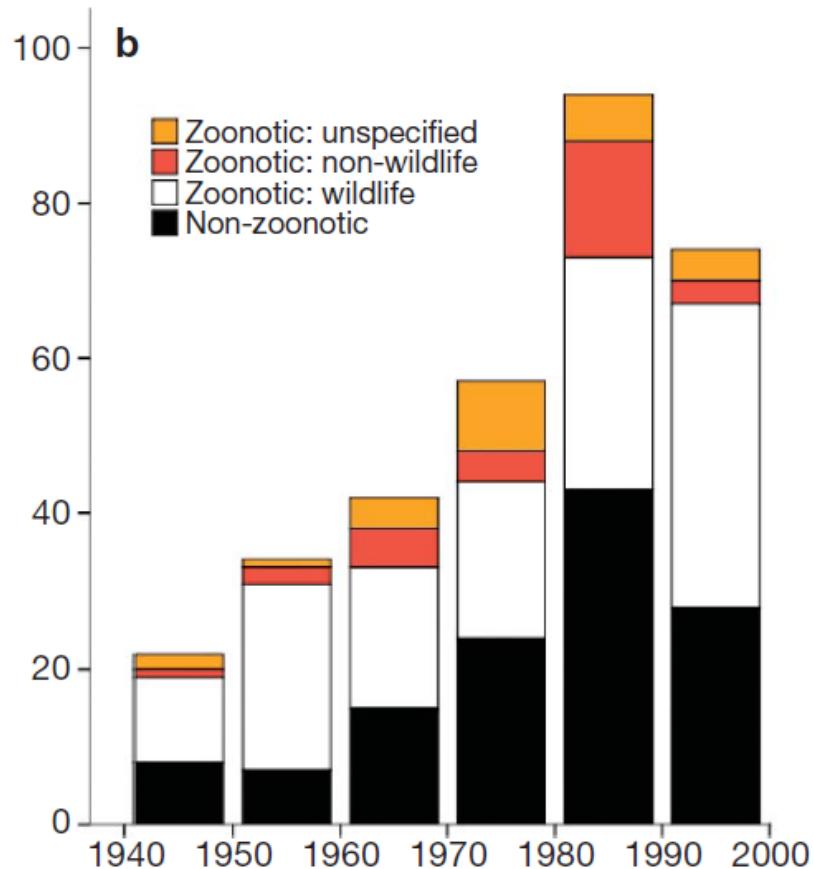
Degradation has significantly altered Earth's ecosystems

- ~80% of terrestrial and marine regions on the planet are substantially altered by people
- Globally, only 40.5% of forest areas have high landscape level integrity (mostly in Canada, Russia, Amazon, Central Africa, New Guinea)
- Increasingly transgressing catastrophic environmental boundaries

Grantham et al. (2020) Modification of forests by people means only 40% of remaining forests have high ecosystem integrity. bioRxiv preprint:

<https://doi.org/10.1101/2020.03.05.978858>

The majority of emerging infectious diseases (EIDs) are zoonotic



Jones et al. (2008) Nature

- 52% of all EIDs originated in wildlife
- Among emerging zoonoses, 72% of outbreaks originated in wildlife (rest from domestic animals)
- Frequency of outbreaks originating in wildlife increasing
- Populations of wild animals carry higher diversity of types of infectious diseases that could potentially jump to humans
- Higher diversity of agents where diversity of host animals is higher

Jones et al. (2008) Nature

Anthony et al. (2017) Virus Evolution



- Connected human society greatly increases long-distance transport of disease vectors, increasing # of human-wildlife interfaces (e.g., at markets)
- Connectivity also facilitates subsequent human-human transmission

Tatum et al. (2006) PNAS



- <300 viruses from 25 high-risk viral families known to infect people
- BUT – estimated 1.7M viruses from same viral families not yet discovered in mammals & birds, of which ~700,000 predicted zoonotic disease potential

Carroll et al. (2018) Science



Ecological degradation increases overall risk of EIDs

- Large-scale studies support conclusion that large-scale ecosystem disturbance associated with increased risk of spillover (though few such studies exist)
- Asia-Pacific: # zoonotic disease outbreaks positively correlated with # threatened mammal & bird spp.
- # vector-borne disease outbreaks negatively correlated with forest cover
- More zoonotic diseases found in threatened spp. facing decline in habitat or high pressure from exploitation compared to those threatened from other reasons
- Following biodiversity loss, weedy species with no extinction risk (e.g., rats) are significant carriers

Morand et al. (2014) PLoS ONE

Johnson et al. (2020) Proc R Soc B



Photo © WCS Vietnam

Reducing the risk of future emerging infectious disease outbreaks by changing social norms around urban bushmeat consumption and stopping its commercial trade

WCS Central Africa

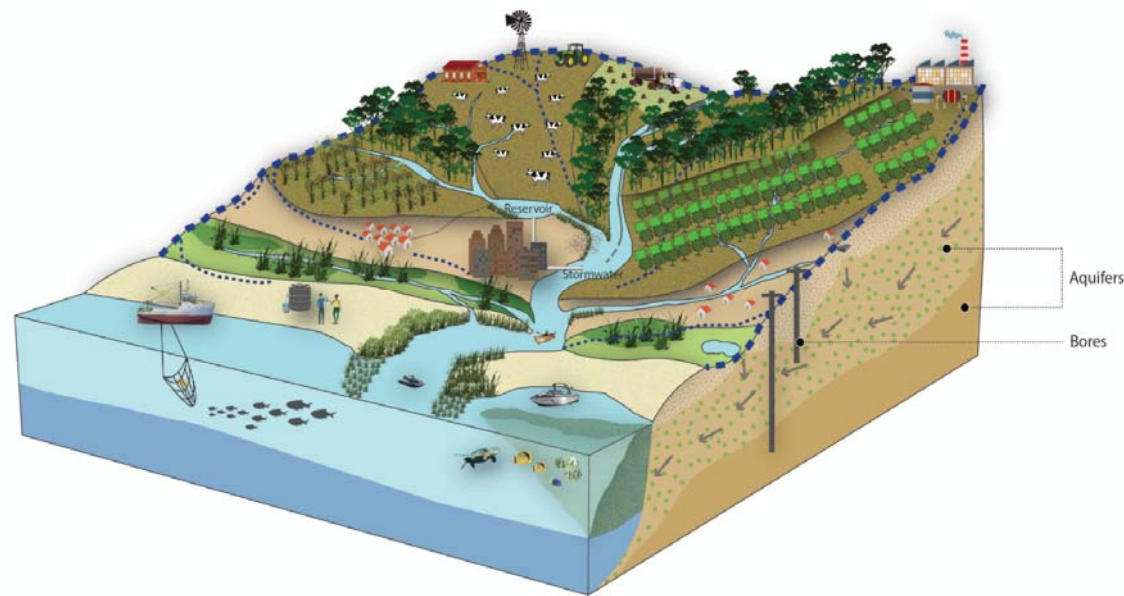


Transmission Mechanisms

- Increased contact between humans, livestock and pathogens along newly created edges
- Increased contact with humans along wildlife trade chains
e.g., Huong et al. (2020) Coronavirus testing indicates transmission risk increases along wildlife supply chains for human consumption in Viet Nam, 2013-2014. BioRxiv preprint: doi: <https://doi.org/10.1101/2020.06.05.098590>
- Changes to pathogen abundance due to changes in host abundance, diversity and susceptibility
- Rapid evolution/mutation of pathogens due to novel conditions and novel hosts (possible)
- Declines in ecosystem biodiversity can increase or decrease the risk of disease transmission among remaining species ('dilution' and 'amplification' effects possible)

Degradation of ecosystems has other complex, often negative, effects on other aspects of human health

- Recent forest loss associated with mosquito-borne disease (though higher forest cover associated with higher rates)
- Lower forest cover associated with higher rates of diarrheal disease (Herrera et al. 2017), and typhoid in Fiji (Jenkins et al. 2016)
- Other established connections between environmental degradation and human health related to changes in air quality and resource availability & quality that affect illnesses, nutrition and mental health



Calls for a “nested, systems approach” to managing for health

<https://medium.com/@WCS/better-environmental-management-required-for-one-health-ee404467911>

Better Environmental Management Required for One Health



Wildlife Conservation Society [Follow](#)

Apr 7 · 5 min read ★



By Stacy Jupiter | April 7, 2020





WISH

Watershed Interventions for
Systems Health in Fiji



**SECURING
THE HEALTH
AND WELL-BEING
OF FIJI AND ITS PEOPLE**

DONORS



PARTNERSHIP



AIMS:

- Reduce the incidence of water-related diseases in people and downstream coral in 5 watersheds in Fiji
- Empower communities to access and maintain their fundamental right to clean water
- Strengthen connections to place to enhance environmental stewardship and to maintain cultural practice
- Develop a coordinated mechanism for systems health governance between communities and government, and across commercial sectors
- Facilitate approaches to sustainably finance and scale interventions nationally



- Health surveillance
- Individual behavior change
- Improving immunity



- Global negotiations
 - Protection & restoration
 - Infrastructure improvements



OCEANIA PLANETARY HEALTH FORUM

NOVEMBER 5-6, 2018

STRENGTHENING PARTNERSHIPS FOR NATURE & HUMAN HEALTH






Join the conversation to set the regional discourse on Planetary Health

Building on the Healthy Islands ideal first advanced in Oceania more than 20 years ago, this forum will bring together key stakeholders to review recent developments in the broad field of ecology and health, and identify priority next steps for the region.

OUTPUTS:
Compendium of Oceania case studies
Communiqué for global policy dialogue
Regional research framework

VENUE:
Sofitel Resort & Spa, Denarau, Nadi, Fiji

For more information contact:
Dr. Aaron Jenkins
aaron.jenkins@sydney.edu.au



A Call to Action

- **Encourage** existing networks to establish platforms to facilitate dialogue and collaboration between the health and environment sectors
- **Provide** the necessary resources to enable joint decision-making across sectors pertinent to health and environment, like those now being developed for emergency response and preparedness in the face of disease outbreaks and natural disasters
- **Establish** the necessary legal and administrative arrangements to enable the health, environment and natural resource management sectors to work and plan together
- **Recognize** Indigenous leadership and local cultural knowledge as foundational and universally meaningful, and actively seek the engagement of Indigenous leaders in decision-making;

McFarlane et al. (2019) Ecosystem Services



For more information: sjupiter@wcs.org

