ECOHEALTH NEWS FROM THE IAEH

Aspirational Statement from the One Health Ecohealth 2016 Congress in Melbourne, Victoria, Towards a Healthier Future Through Converging Communities of Inquiry and Practice 197

LETTERS TO THE EDITOR

Non-human Hosts and Zika Virus Maintenance
Sara Yarsi, Viroj Wiwanitkit 200

Are Reptiles Reservoirs of Leptospirosis? A Brief Discussion Based on Serological Studies
Felipe Fornazari 203

IN THIS ISSUE

EDITORIAL

An Introduction from Kerry Arabena, the New IAEH President
Kerry Arabena 208

FORUMS

Ecosystem Approaches to Community Health and Wellbeing: Towards an Integrated Australian Governance Framework in Response to Global Environmental Change
Jonathan Kingsley, Sebastian Thomas 210

Phylogenetic Insight into Zika and Emerging Viruses for a Perspective on Potential Hosts
Diana S. Weber, Karen A. Alroy, Samuel M. Scheiner 214

ORIGINAL CONTRIBUTIONS

Enteroparasitoses and Toxocarosis Affecting Children from Mar del Plata City, Argentina
Carla Lavallén, Beatriz Brignani, Karina Riego, Amalia Rojas, Gabriela Colace, Martin Biscaychipi, Estela Chivoti, Cristian Giuntini, Marcela Kifer, Maria Eugenia del Rio, Guillermo Denegri, Marcela Dopchiz 219

Estimating Loss of Brucella Abortus Antibodies from Age-Specific Serological Data In Elk

Biosecurity Conditions in Small Commercial Chicken Farms, Bangladesh 2011–2012
N. A. Rimi, R. Sultana, M. Muhina, B. Uddin, N. Haider, N. Nahar, N. Zeidner, K. Sturm-Ramirez, S. P. Luby 244

Could Malaria Control Programmes be Timed to Coincide with Onset of Rainfall?
Kibii Komen 259

Seasonal Fluctuations of Astrovirus, But Not Coronavirus Shedding in Bats Inhabiting Human-Modified Tropical Forests

Batrachochytrium dendrobatidis and the Decline and Survival of the Relict Leopard Frog
Jef R. Jaeger, Anthony W. Wadde, Rebecca Rivera, D. Tyler Harrison, Silas Ellison, Matthew J. Forrest, Vance T. Vredenburg, Frank van Breukelen 285

Survey of Pathogenic Chytrid Fungi (Batrachochytrium dendrobatidis and B. salamandrivorans) in Salamanders from Three Mountain Ranges in Europe and the Americas
Joshua Curtis Parrott, Alexander Shepack, David Burkart, Brandon LaBumbard, Patrick Scimè, Ethan Baruch, Alessandro Catenazzi 296

On the Cover: Bruce Armstrong’s “Eagle (Bunjil) 2002”, Docklands Precinct, Melbourne, Australia. Collection of the Victorian State Government (Places Victoria). This artwork was sponsored by the generous support of EcoHealth Alliance.
Characterization of Staphylococcus aureus in Goose Feces from State Parks in Northeast Ohio 303
Dipendra Thapaliya, Mark Dalman, Jhalka Kadariya, Katie Little, Victoria Mansell, Mohammed Y. Taha, Dylan Grenier, Tara C. Smith

Exposure of Threatened Accipitridae to Mycobacterium bovis Calls for Active Surveillance 310
Mónica V. Cunha, Beatriz Azorín, Rocío G. Peñuela, Teresa Albuquerque, Ana Botelho

Symptomatic Raccoon Dogs and Sarcoptic Mange Along an Urban Gradient 318
Masayuki U. Saito, Yoichi Sonoda

Ecology and Feeding Habits Drive Infection of Water Bugs with Mycobacterium ulcerans 329
Solange Meyin A. Ebong, Gabriel E. García-Peña, Dominique Pluot-Sigwalt, Laurent Marsollier, Philippe Le Gall, Sara Eyangoh, Jean-François Guégan

REVIEWS

Epidemiological Risk Factors for Animal Influenza A Viruses Overcoming Species Barriers 342
Kate A. Harris, Gudrun S. Freidl, Olga S. Munoz, Sophie von Dobschuetz, Marco De Nardi, Barbara Wieland, Marion P. G. Koopmans, Katharina D. C. Stärk, Kristen van Reeth, Gwen Dauphin, Adam Meijer, Erwin de Bruin, Ilaria Capua, Andy A. Hill, Rowena Kosmider, Jill Banks, Kim Stevens, Sylvie van der Werf, Vincent Enouf, Karen van der Meulen, Ian H. Brown, Dennis J. Alexander, Andrew C. Breed, the FLURISK Consortium

A Review of Zoonotic Infection Risks Associated with the Wild Meat Trade in Malaysia 361
Jennifer Caroline Cantlay, Daniel J. Ingram, Anna L. Meredith

Retrospective Study of Leptospirosis in Malaysia 389
Bashiru Garba, Abdul Rani Bahaman, Siti Khatirani-Bejo, Zunita Zakaria, Abdul Rahim Mutalib

Policies and Livestock Systems Driving Brucellosis Re-emergence in Kazakhstan 399
Wendy Beauvais, Richard Coker, Gulzhan Nurtazina, Javier Guittian

The Influence of Dams on Malaria Transmission in Sub-Saharan Africa 408
Solomon Kibret, G. Glenn Wilson, Darren Ryder, Habte Tekie, Beyene Petros

WHAT’S NEW

About the Cover Art 420

Book Review 425

Acknowledgments 428

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Dear Editor,

The publication on “Non-human Hosts and Zika Virus Maintenance” is very interesting (González-Salazar et al. 2017b). González-Salazar et al. noted “using a spatial data mining framework to identify potential biotic interactions, based on the degree of co-occurrence between different species, we identified those mammal species with the highest potential for establishing mammal-vector interactions, considering as principal vector Aedes aegypti. Seven of the top ten identified mammal species with highest potential were bats, with two of them having previously been confirmed as positive hosts for dengue in Mexico.” In fact, the zoonotic transmission of arbovirus becomes a new concern at present. Several animals might carry the viruses, and they might further cause the outbreak. Of several animals, pets should be seriously concerned. We would like to share ideas and experiences from tropical Asia, where the Zika virus infection is also epidemic. For dengue, there is a recent report that a dog can be a host (Joob and Wiwanitkit 2016). Additional, the recent report from Thailand also indicates that the dog might also be the host of Zika virus (Joob and Wiwanitkit 2017). While there are many reports on disease control for Zika virus infection, there is only a little concern on zoonosis. There is an urgent need to focus on “non-human hosts and Zika virus maintenance.” While González-Salazar et al. mentioned for bats, we hereby add a more serious consideration on pets, especially for dogs.

REFERENCES


RESPONSE TO LETTER TO THE EDITOR “NON-HUMAN HOSTS AND ZIKA VIRUS MAINTENANCE”

Sora Yasri’s observation of the potential relevance of pets, and especially dogs, in the transmission of Zika is both complementary and very pertinent to our recent paper “Non-human Hosts and Zika Virus Maintenance” (González-Salazar et al. 2017a). Dogs and other domestic animals are known to be hosts for several flavivirus (Singh et al. 2015; Davoust et al. 2016; Maquart et al. 2016), although their epidemiological relevance is not fully understood (Vorou 2016). Importantly, however, they could serve as potential bridges between sylvatic, peri-domestic and domestic environments, and therefore between...
potential enzootic and epizootic transmission cycles. We believe that bidirectional transmission between these distinct habitats can play an important role in the epidemiological dynamics of many zoonosis, such as Zika and dengue, potentially offering a non-urban safe haven between disease outbreaks.

Furthermore, consideration of dogs and other domestic animals illustrates the importance of understanding the role of each potential mammal host in terms of its particular ecological niche. For instance, dogs are potentially important due to their special association with man, while bats are potentially important due to their capacity to propagate a zoonosis across large distances. In terms of niche, much is often made of the urban characteristics of *Aedes aegypti* and dengue, for instance (Brown et al. 2014; Ho et al. 2016). However, it is important to remember that such zoonoses had a sylvatic origin. So, though the preferred habitat may be urban, that does not mean that sylvatic transmission cycles are completely absent, or irrelevant, or could not be re-established if presently absent. Additionally, laboratory tests demonstrating the low degree of competence of different potential hosts do not necessarily reflect on the ground realities. For instance, low, versus zero, competence of a host may imply that it does not play an epidemiologically significant role when compared to other more competent hosts. However, in the absence of such competent hosts it may be the only way for a pathogen to remain viable. Such experiments can indicate that there exist important heterogeneities between hosts, which could be an important factor in their epidemiological relevance. However, unless transmission rates are effectively negligible they cannot prove the absence of transmission cycles involving, say, low-competence hosts. In other words, host–vector interactions take place in a complex ecological environment, not in a laboratory, and the relative importance of a host is just that relative. That is not to say, of course, that laboratory experiments cannot offer important information about the relative importance of different interactions. For instance, the recent paper Bardina et al. (2017) showed the importance of cross-reactivity among flavivirus, finding that mice having been infected with dengue had a much higher mortality in the presence of Zika. Additionally, the impact of a pathogen could well be enhanced due to immunosuppressive effects in the presence of another infection. All these considerations just indicate the importance of a multi-pathogenic, multi-vector, multi-host point of view.

With all this in mind, we consider Joob and Wiwanitkit’s (2017) work to be very relevant, consistent with our conclusions that it is important to maintain an open mind on the potential role of non-human hosts in Zika virus transmission and to further develop models and corresponding experimental protocols to better understand it (Joob and Wiwanitkit 2017). Finally, dogs were not considered in our paper simply because we had no corresponding collection data as a measure of their geographic distribution. In the absence of such, given the close association between dog and man, a reasonable proxy could be the presence of human settlement. It would be interesting to include in either directly or indirectly information associated with the geographic distributions of domestic animals as subsequent analysis could evaluate their potential relative importance and also indicate the most likely bridging routes between sylvatic, peri-domestic and domestic cycles.

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Are Reptiles Reservoirs of Leptospirosis? A Brief Discussion Based on Serological Studies

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Recently, a paper in EcoHealth by Pérez-Flores et al. (2017) on the risk of human leptospirosis from Mexican crocodiles caught my attention because it involves an interesting and poorly studied subject: the role of reptiles as reservoirs of leptospirosis and their risks for public health. My goal here is not to disagree with the authors’ statements, but to contribute to the discussion on this topic and consider other publications that have presented similar results. This brief contribution focuses mainly on the importance of the Microscopic Agglutination Test (MAT) to predict the reservoir status of reptiles.

A great number of mammal species can harbor leptospires in their tissues. For a long time researchers have wondered whether reptiles can also carry leptospires, and some studies conducted decades ago have shown evidence of this hypothesis (Glosser et al. 1975). Surprisingly, little research on this subject was performed since then. The few studies in the literature are usually limited to low sample size and serological tests. Thus, leptospirosis in reptiles still remains an unexplored field, besides the great relevance of the disease and the high biodiversity of this animal group.

MAT is the standard serological test for leptospirosis and has been the most employed in studies with reptiles, but what conclusions may we draw from this test? A common mistake I have often observed in the literature is that MAT positivity “suggests that reptiles may play a role as reservoir of leptospirosis”. In my opinion, such conclusion is usually precipitated. MAT indicates the presence of antibodies against leptospires, thus, it suggests the level of exposure against this pathogen—without necessarily the development of chronic infection, which is a necessary condition that defines a reservoir of leptospirosis. My statement is based on the scientific literature, which indicates the poor value of MAT as a predictor of chronic infection (Harkin et al. 2003; Lilenbaum et al. 2009; Ellis 2015). This fact is justified by several intrinsic limitations of MAT, the characteristics of etiological agent and the immune response of infected animals. These aspects have been widely discussed and I recommend the cited literature for detailed information (Levett 2001; Ellis 2015). I will focus here on why seropositive animals are usually not reservoirs of leptospirosis.

Consider the following conditions in Leptospira infection: low pathogenicity of the infecting strain; low infectious dose; and low specificity between the infected animal species and the Leptospira strain. Such conditions exemplify how animals will not necessarily develop chronic infection but may have anti-Leptospira antibodies—and a positive result in MAT. In the two first cases, a common outcome is the rapid suppression of leptospires by the immune system, without further development of infection. In the third example, an acute infection may progress, characterized by bacteremia, dissemination of leptospires in various tissues and manifestation of disease symptoms. However, the maintenance of bacteria in renal tissue will probably not
occurred and, consequently, the infected animal cannot be considered a reservoir. This failure to establish a chronic infection is particularly common when leptospires are not adapted to a given host. Still, this latter case usually results in a stronger immune response compared to the other two, with higher and lasting antibodies titers.

Therefore, we should consider that several—and unknown—factors influence the dynamics of *Leptospira* infection, although only a few examples have been presented here. It is extremely difficult to establish an association between MAT and infection status due to many variables related to bacterial diversity, laboratorial tests and animal species. For instance, high antibody titers in MAT can indicate chronic infection, but the contrary is also true, and animals without evidence of leptospires in kidneys commonly exhibits high antibody levels (Harkin et al. 2003; Fornazari et al. 2012; Vieira et al. 2016). One of the few consensuses in the literature is that titers equal to or higher than 800 in MAT indicates recent infection. But even this criterion is constantly under discussion and is considered invalid by many researchers. One exception that may contradict my standpoint occurs when high prevalences are obtained for a single serovar. In this case, the reservoir status is more likely. A classic example is the high positivity of Norway rats (*Rattus norvegicus*) for Icterohaemorrhagiae serovar.

In view of the broad utilization of serological tests on reptiles and the lack of data regarding the pathophysiology of leptospirosis in these animals, I emphasize the need for a careful interpretation of MAT to avoid hasty conclusions. In addition to consistent epidemiological or molecular analysis, we could make deeper inferences on the MAT results. But in the absence of such studies, I consider the reservoir status of reptiles doubtless based only in serological tests.

I truly believe that reptiles can be natural reservoirs of certain *Leptospira* strains, given the (1) cosmopolitan nature of this bacterium, (2) the close contact of some animals with aquatic biomes, such as crocodilians and chelonians, (3) and the evidence of leptospires in reptiles using direct tests of diagnosis, particularly the polymerase chain reaction (PCR). But, as far as I know, there is still no strong evidence of any reptile species as an important reservoir of leptospirosis, given that the few publications using PCR reported low prevalences (Biscola et al. 2011; Alves Júnior 2013; Jobbins and Alexander 2015). A recent study in Brazil presented interesting results on this topic, in which a considerable positivity (16.6%; 11/66) was found in Geoffroy’s side-necked turtles (*Phrynops Geoffroi anus*) using PCR in cloacal and gastric content (Oliveira et al. 2016). Similar research including large sample sizes and direct methods of diagnosis is urgently needed to complement current and future serological studies.

**References**


An Introduction from Kerry Arabena, the New IAEH President

A RE-VISIONED MANIFESTO: RISING TO OUR PHOENIX MOMENT

I acknowledge the traditional owners, leaders and lands of Indigenous peoples around the world and acknowledge all those who have a continued connection to Country. I celebrate your resilience and contributions to our world.

To all our ‘Exquisite Elders’ from different knowledge traditions who pioneered EcoHealth and created for us all a path that we may now follow; we are proud of your achievements and humbled by the opportunity to follow you. We thank you for your thought leadership and generosity in sharing your insights. These gifts set us in good stead for the civilisational transition that is our generation’s to make, and we look forward to respectfully engaging you over the coming year.

On behalf of the Board of Directors for the International Association for Ecology and Health, it is my pleasure to acknowledge the tremendous effort and legacy of past Presidents and retired Directors of the Board and offer them a vote of thanks. We salute our retiring President, Professor Jakob Zinsstag, and retiring Board members - Associate Professor Edouard Kouassi, Professor Nitish Debnath and Adjunct Professor Karen Morrison. These Board members made significant contributions to the progression of EcoHealth ideals through their commitments to membership, regional chapter development, student engagement and Board functioning.

We also acknowledge and offer a vote of thanks to Lisa Crump, EcoHealth Journal staff and office holders for their active participation in the business of the Association, and their provision of secretariat, administrative and communication supports during the past term. We extend a warm welcome to incoming Board members including Dr. Hung Nguyen, Dr. Neville Ellis, Dr. Hume Field and Arron Jenkins.

We are delighted to have conferred 2016 EcoHealth Awards to worthy winners in a ceremony at the inaugural OneHealth EcoHealth Congress held in Melbourne last December 2016. From a competitive field, Emeritus Professor Valerie Brown received the Lifetime Achievement Award in recognition of her years of contribution, achievement, student engagement and support. Professor Brown was joined by Dr. Jonathan Kingsley and Dr. Hung Nguyen as Exceptional Early Career Award Winners and Kouassi Richard M’Bra, Melanie Bannister-Tyrrell and Melanie Voevodin took out the Student Awards.

The Organising Committee of the Congress committed to a process that facilitated the involvement of over one thousand delegates from over eighty-six countries and over 170 scholarship holders. Front and centre of the joint Congress was the strong student and early career delegations who together developed the Aspirational Statement from the Conference, a living document that the Board are committed to incorporating in our future work. The Aspirational Statement will form part of the re-visioning efforts by engaging with members and affiliates in a strategic planning process to consider governance and...
constitutional enhancements. This process will embed the work of the Association through regional chapters explore how to support these initiatives around the world, improve our communications with members and support the 2018 EcoHealth Biennial Conference in Cali, South America. In addition to these specific pieces of work, the Association will be negotiating our current and future business and governance relationships, putting in place mechanisms for building local and regional capacity and creating strong partnerships with scholars, students and organisations.

Our aims are clear: we are in a unique position with untapped potential, a growing number of individual and organisational members, a ‘new look’ website and an Aspirational Statement from students. There is a strong commitment to a European chapter and the appointment of Board members with a track record of transformational change. Part of our re-visioning exercise will be to explore the interface between the many emergent Associations and to define our role as distinct from, but committed to, joint programs of action to facilitate our way forward in the world, and to consider future global megatrends that will change the way we live. Another part of that re-visioning is to acknowledge what we have failed to deliver, find our peace with that, then strip away those things that are inessential, and work only on those things that matter the most.

Oftentimes, it is during these reflective moments that we find the determination we need to succeed. To succeed we need to heal relationships between all peoples and the places where we live through sustainable programs of activity, then scale these over time; we need to be cognisant of future global trends; and we need to co-create knowledge transfer, capacity building and sustainability of these initiatives with people who will be impacted by our approach. This is our Phoenix moment. This is what lies ahead of the Association’s members, of our partners and of other emergent entities in ecology and health.

It sounds simple, but simplicity has been difficult to implement in modern life because it goes against the spirit of a certain brand sophistication used to justify professions, positions and revenue sources. Less is more, and usually more effective. In this context, ‘simple’ does not mean ‘less volatile’. In fact, what we require of ourselves is to joyously embrace uncertainty, variability, imperfection, incomplete knowledge, chance, chaos, disorder and errors. In doing so, we will have a positive and genuine impact on the health and wellbeing of living systems and all who reside within them.

Together, we need to decide what we can do, in our little piece of the world, in the 80 or so years that we have to live. Some will do this through social media, webinars and presentations, projects, caring for Country initiatives, building an EcoHealth workforce, writing publications and shifting our language from one of deficit to one of strength. Others will bring sectors together, challenge the outer bounds of their own knowledge traditions, develop new methodologies founded in diversity, coherence and equality. All of us, moving into the 21st century, will need to hone our skills and redefine our roles as individuals and in organisations and invest in meaningful relationships that facilitate compassionate responses to the issues before us, drawing on the source of strength behind us.

We, the members of the International Association for Ecology and Health Board, seek to engage with you on re-visioning our Manifesto by describing our niche, values, focus and the opportunities before us. This might facilitate a transition from a global EcoHealth framework to eco-socio-cultural-health frameworks that are regionally embedded and link together to form a global presence. In this task, we will join with our multiple generations of EcoHealth scholars and practitioners with activists, artists, and members of other associations to realise the aspirations of our emerging scholars and practitioners: to negotiate a shared identity, leverage shared values, strengthen collaborations and integrate knowledges in the places where we live, play and love.

In Unity,
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In This Issue

Australian Health and Wellbeing

Kingsley and Thomas explore how to best integrate ecological and human concerns within governance structures. Their article highlights challenges to wellbeing discourse in research and policy frameworks and presents a case study from Australia that demonstrates complex social-ecological health problems in the region. They advocate for the need to reshape governance institutions to better engage with complex social-ecological health problems and to highlight that Australia offers an international relevant case study to address this task.

Insight into Zika and Emerging Viruses

Despite global viral diversity, most viruses receive minimal attention until a public health emergency. Lack of knowledge in the basic biology and ecology of an emerging virus makes predicting a future threat difficult. Weber et al. suggest using a pathogen phylogenetic framework with infected host species for insight into which may serve as reservoirs. For flaviviruses closely related to Zika virus, the phylogenetic framework suggests initial animal surveys for potential reservoirs should focus on New World monkeys as the most likely candidates. Mammals such as livestock in close proximity to humans have increased opportunities for pathogen exchange, and this analysis suggests these should also be evaluated.

Parasites in Argentina

Lavallén et al. evaluate enteroparasitoses and toxocarosis in children of peripheral and urban communities from Mar del Plata. A higher number of peripheral compared to urban children were parasitized. *Toxocara canis* IgG was more prevalent in peripheral children, seemingly caused by inadequate hygienic maintenance after direct contact with animals. A Parasite Vulnerability Index was established using socio-environmental variables to assess the risk of parasite infection in families. The peripheral communities showed higher frequencies of families with high and medium parasite vulnerability associated with enteroparasitoses and toxocarosis.

Brucellosis at Home and Abroad

Serological data are one of the primary sources of information for disease monitoring in wildlife species. However, the duration of antibodies is often unknown for many free-ranging host species. Bendavides et al. used a Bayesian statistical approach to infer brucellosis infection, antibody loss, and recovery rates of elk in the Greater Yellowstone Ecosystem. Results suggest that seroprevalence declined above the age of ten due to antibody loss without further re-infection and that around half of the population requires vaccination to eradicate the disease. Beauvais et al. analyzed policies in relation to brucellosis in Kazakhstan and found that high livestock densities on farms may play a key role.

Bird Flu Biosecurity in Bangladesh

Rimi et al. conducted observations, in-depth interviews, and group discussions with poultry farmers and feed sellers from in Bangladesh to understand the biosecurity conditions and the perceptions of avian influenza biosecurity. Some farmers used measures that involved additional cost or effort to protect their flocks. The survey results suggest
that small commercial farmers could be motivated to maintain biosecurity with interventions that protect their investment and maintain profitability by keeping their flock safe from diseases they consider harmful through the involvement of local vendors they value.

MALARIA IN AFRICA

Malaria cases in South Africa’s Northern Province of Limpopo have surpassed those reported in nearby provinces where it is endemic. Komen applied statistical methods to understand the timing and duration of malaria outbreaks. The onset of rainfall was shown to trigger a ‘malaria season’. The author recommends that cost-effective Malaria control programs and an early warning system should be implemented prior to annual rainfall. Kibret et al. review the impact of dams on malaria across Sub-Saharan Africa. While dams are economically important infrastructures, their potential impact on malaria needs special attention in the planning, implementing, and operating of dams. The authors found that dams increase malaria in semi-arid areas, where malaria transmission is seasonal.

OLD WORLD BATS

Most emerging infectious diseases seem to result from an increased contact zone between wildlife and humans. Seltmann et al. tested whether habitat disturbance is indeed associated with the occurrence of astroviruses and coronaviruses in eight bat-species in a paleotropical forest with ongoing anthropogenic landscape modification. While the authors could not find evidence of any association, the detection rate of astroviruses was higher during the rainy season and in individuals with poor body condition. The identification of seasonality as an important factor for increased viral shedding may help in the prevention of viral spillovers from bats to other animals including humans.

GLOBAL Bd

Although the role of Batrachochytrium dendrobatidis (Bd) in the decline of the relict leopard frog (Rana onca) remains hypothetical, Jaeger et al. detected Bd in R. onca and in other anurans within its historical range. However, when they were infected with two hypervirulent Bd isolates, survivorship was unaffected and most frogs being capable of clearing infections. The authors propose that R. onca either has inherent resistance to Bd or has recently evolved such resistance. Parrott et al. screened specimens of salamanders representing 17 species inhabiting the Smoky Mountains, the Swiss Alps, and the Peruvian Andes for Batrachochytrium salamandrivorans (Bsal) and Bd. Bsal was not detected and Bd was absent except for one location in the Andes.

FERTILIZER FROM ABOVE

Canadian geese (Branta canadensis) are able to produce up to 1.5 lbs of fecal material each day, which may contain a variety of pathogenic bacteria. Thapaliya et al. examined fecal samples from B. canadensis for the presence of Staphylococcus aureus, a bacterium that can cause a variety of disease in humans. They found that S. aureus was present in 7.1% of goose samples, suggesting that geese may play a role in transmission of this bacterium into the environment.

SPOILED MEAT

Cunha et al. surveyed 55 scavenger vultures including Eurasian griffons and Eurasian black vultures from several regions in Portugal where these species qualify as endangered. Pathogenic and opportunistic mycobacteria were detected in the oropharynx of nine vultures exclusively in hotspot areas for animal tuberculosis. Genetic relatedness between the Mycobacterium bovis strain found in vultures, with bovine and deer strains from the same region raise questions about infection source, transmission risk, and suitability of current vulture feeding methods.

MANGY MUTTS

Saito and Sonoda evaluated the effects of landscape factors on the distribution of sarcoptic mange in raccoon dogs along an urban gradient. High occurrence probability of mange in raccoon dogs appeared in non-forest and intermediate forest landscapes, indicating that an urban landscape has an important role in the occurrence of sarcoptic mange in raccoon dogs.
MU IN WATERBUGS

Some studies assume that Naucoridae and Belostomatidae insects have symbiotic relationships with *Mycobacterium ulcerans* (MU) the causative agent of Buruli ulcer. Other studies assume that MU can be transmitted to any animal that lives in ecological settings where MU accumulates, such as a river dam. *Ebong et al.* examined these possibilities through phylogenetic comparative analysis in 10 regions of Cameroon. Their results suggest that MU infects animals living in the aquatic vegetation and through the trophic network. They also show that Naucoridae and Belostomatidae insects may have symbiotic relationships with MU.

INFLUENZA’S A COMING

*Harris et al.* carried out a literature review to identify scientific publications with evidence of epidemiological risk factors for influenza A viruses transmitting between animals and from animals to humans. They identified a knowledge-gap regarding these risk factors and particularly a lack of studies that included a statistical measure of risk factors. With reference to animal to human transmission in particular, most studies involved various influenza strains, but these risk factors may not directly correlate to viruses less adapted to poultry, which could still present equivalent or higher public health threats.

LEPTOSPIROSIS IN SOUTHEAST ASIA

Leptospirosis is emerging as an important zoonotic disease in Malaysia and in Southeast Asia as the number of cases recorded and outbreaks increases following heavy rainfall or flooding. *Garba et al.* stressed the necessity of Malaysian government intervention in reducing the number of cases and generating public awareness for leptospirosis.

WILD MALAYSIAN MEAT

The wildlife trade for food poses zoonotic infection risks to hunters in contact with animals or carcasses and consumers of wild meat, which threaten the health of individuals and human populations. *Cantlay et al.* provide a database of zoonotic information that identifies viral, bacterial, and parasitic pathogens that are potentially transmissible to people from wildlife species traded in Malaysia. This evidence could aid targeted epidemiological monitoring and surveillance of harvested wildlife and at-risk human populations in Southeast Asia.
What’s New

Welcome Kerry Arabena, the New President of the IAEH

We welcome Dr. Kerry Arabena as the new President of the International Association for Ecology and Health. Dr. Arabena is currently the Chair of Indigenous Health and Director of the Indigenous Health Equity Unit at the Melbourne School of Population and Global Health, University of Melbourne, Australia.

Uppsala Health Summit 2017: Managing Infectious Disease Threats

The Uppsala Health Summit 2017 brings together diverse voices and perspectives to unlock implementation challenges and help improve the utilization of medical advancements globally and where resources are scarce. The 2017 summit will focus on priorities for preventing, detecting, and responding to emerging infectious diseases, using a One Health approach.

October 10–11, 2017, Uppsala University, Sweden

http://www.uppsalahealthsummit.se

World Health Summit 2017

The World Health Summit has become the world’s most prominent forum for addressing global health issues. This annual forum aims to improve global health by fostering collaboration and open dialogue. Researchers, physicians, key government officials, and representatives from industry, NGOs, and healthcare systems all over the world will address pressing issues facing healthcare and medicine.

October 15–17, 2017, Berlin, Germany

https://www.worldhealthsummit.org

Book Releases!

Everyday Exposure: Indigenous Mobilization and Environmental Justice in Canada’s Chemical Valley. Sarah Marie Wiebe uncovers the systemic injustices faced on a daily basis by the Aamjiwnaang First Nation near the Ontario–Michigan border, Canada’s densest concentration of chemical manufacturing. By exploring the problems that Canada’s conflicting levels of jurisdiction pose for the creation of environmental justice policy, analyzing clashes between Indigenous and scientific knowledge, and documenting the experiences of Aamjiwnaang residents as they navigate their toxic environment, Wiebe book argues that social and political change requires an experiential and transformative “sensing policy” approach, one that takes the voices of indigenous citizens seriously.


Climate Change and the Health of Nations. This posthumous book from Anthony McMichael—renowned

World Vaccine Congress Europe 2017

The 18th annual World Vaccine Congress is a joint congress collocated with the 3rd World Veterinary Vaccine Congress and 2nd Immune Profiling World Congress. The congress focuses on the future of vaccine research, development, and manufacturing providing opportunities for networking with other attendees seeking solutions to challenges around commercial and scientific issues in manufacturing, trials, strategy, regulation, veterinary, immune profiling, respiratory, therapeutic, and emerging diseases vaccines.

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http://www.terrapinn.com/conference/world-vaccine-congress-europe/index.stm
epidemiologist and a pioneer in the field of how human health relates to climate change—takes the reader on a tour of 200,000 years of human history through the lens of changing climate. McMichael's aim is not to make predictions, but to motivate change by bringing into focus humanity’s sensitivity to fluctuations in the natural climate system throughout history. As McMichael lyrically and lucidly relates, climate change is a primary cause of break-up of the Roman Empire, the bubonic Plague of Justinian, and the mysterious collapse of Mayan civilization.
Imagine a sweeping history of human health in relation to the environmental influences (especially climate) that shaped us. Imagine that the book was written by a crack team that included an epidemiologist, a physician, a historian, a cultural anthropologist, a paleontologist, a climatologist, a geologist, and an evolutionary biologist. This is that book. What's remarkable is that every member of that crack team was Tony McMichael.

McMichael, until his untimely death in the autumn of 2014, was Professor Emeritus at Australian National University. He had already established a reputation for scientific prescience and brilliant polyglot scholarship with two earlier books: *Planetary Overload: Global Environmental Change and the Health of the Human Species* (1993) and *Human Frontiers, Environment, and Disease: Past Patterns, Uncertain Futures* (2001). *Climate Change and the Health of Nations* is his third and final opus in this series, published posthumously, with expert editing by Alistair Woodward of the University of Auckland and Cameron Muir of Australian National University.

The story in this book begins with the formation of planet earth, 4.6 billion years ago. Early proto-life appeared about 3.8 billion years ago, and multicellular organisms about 700 million years ago. Our direct ancestors, the *Homo* genus, emerged about 2.5 million years ago, and modern *Homo sapiens* appeared 200,000 years ago. What we recognize as modern life—agriculture and manufacturing, art and culture, towns and cities—is a product of the Holocene epoch, beginning about 11,000 BCE when the
Younger Dryas cooling at the end of the Pleistocene gave way to post-glacial warming.

Climate varies due to many factors: planetary axial and orbital cycles with periods of thousands of years (the Milankovitch cycles), the Hadley Circulation that distributes energy from the equator toward the poles, oscillations including the El Niño Southern Oscillation and the Atlantic Multi-Decadal Oscillation, the thermohaline circulation in the Atlantic Ocean, and more. McMichael describes how changes in the interactions of these forces, and the resulting changes in food and water availability, have influenced societies throughout history. For example, cyclic changes in rainfall patterns in West Africa between the years 800 and 1700 helped drive the rise and fall of the great Ghana, Mali, and Songhai empires.

Throughout history, climate has affected not only the fortunes of various civilizations, but also the health of their people. McMichael describes three principal pathways: the availability of food; the occurrence of infectious diseases; and population displacement and conflict.

Food yields of course reflect far more than climate; they are a function of soil quality (and degradation), water availability, pest infestations, and other factors. But climate has always played a major role. With the shift from the Pleistocene to the Holocene, agriculture became possible. But this was something of a Faustian bargain; turning from hunting and foraging to farming meant a less diverse diet, with less meat and more carbohydrates. Evidence suggests that adult heights declined by as much as 15 cm, and conditions such as anemia and dental caries became more common. Much later, between the eighth and tenth centuries C.E., in Mesoamerica, a long drying trend and intermittent severe droughts probably played a major role in food shortages, and in the subsequent collapse of the Mayan empire. The same was true of the Anasazi in what is now the southwestern USA, and the Cahokian-Mississippian culture in present-day southwestern Illinois. McMichael quotes economic historian Cormac Ó Gráda on this point: “Most of the worst famines on record have been linked to either too much or too little rain” (Ó Gráda 2009). Drought led to hunger, and hunger to disease, mortality and collapse.

Infectious diseases—both those spread by vectors and those spread through food and water—are related to climate in complex and varied ways. McMichael describes the dynamics of smallpox, plague, measles, and other diseases in the late Roman Empire, influenced in part by a cooling climate in the third and fourth centuries C.E. Interestingly, the catastrophic plague of Justinian in 542 C.E., which wiped out a third of Constantinople’s population and eventually spread throughout Eurasia, followed several years of dramatic cooling in Europe, probably due to a massive volcanic eruption in present-day Papua New Guinea. McMichael describes numerous such events and explains potential mechanisms linking climate with disease dynamics.

Tragically, shortages of food, water, and other resources often trigger population displacement, armed conflict, or both. McMichael describes the ebb and flow of civilizations during the Bronze Age, as changing weather conditions brought privation and political upheaval, destabilizing the Sumerian federation and later the Akkadian Empire in Mesopotamia, the Harappan civilization in India, the Hittite kingdom in Anatolia, and others. Waves of invasions and plundering, social disorder and violence, accompanied the changes. Nor is this only of historical interest. McMichael cites systematic research in modern times, supporting the conclusion that “Deviations from normal precipitation and mild temperatures systematically increase the risk of conflict” (Hsiang et al. 2013).

These are not the only health impacts McMichael describes. He addresses the direct effects of heat during warming periods, the mental health effects of climate change, and others. These are best understood in the contemporary context, as historical evidence is patchier than for hunger, infectious disease, and violence.

An important concept McMichael stresses is the “Goldilocks Zone”—the “just right” (not too hot, not too cold) zone in which all contemporary life has evolved. Swings in climate in either direction have typically destabilized the social and ecological systems on which human thriving depends. Importantly, the Holocene has been a time of relative climate stability, with relatively small swings; nevertheless, major impacts on human well-being have been evident. This has clear implications for a coming era of more rapid and extreme excursions beyond the Goldilocks Zone.

In the last two chapters of the book, McMichael pivots from past to future, asking what we can learn from the history of the Holocene that is applicable to the looming climatic stressors and associated risks of the twenty-first century. He notes that “we face a change in global climatic conditions far greater and faster than anything in recorded human history.” He proposes a range of responses: shifting from conventional models of economic growth; advancing sustainable agriculture; improved global governance; eco-
onomic development and poverty reduction in poor countries; systems-based scientific research; an ethic of environmental sustainability.

This book has many virtues. The writing is clear, unadorned, and engaging. The scholarly reach is breathtaking. McMichael never oversimplifies; when evidence is partial or equivocal, he says so, and while the book is centered on climate, he reminds us (p 249) that “climate change is not the only contemporary threat,” citing rising population numbers, soil degradation, biodiversity loss, over-fishing, and other pressures. In the book, as he did in person, McMichael wonderfully combines careful scholarship with passion and conviction about humanity’s need to confront environmental challenges.

If the book has any shortcomings, they lie not with the text but with the graphics. The images in the book are for the most part small and rudimentary, and none are in color. Most readers will find it difficult, as I did, to recall and track the eons, eras, periods, epochs, and ages that form the temporal framework of the narrative; effective timeline graphics are helpful but readers will need to look elsewhere for these. Similarly, many readers will have difficulty following the geographic sweep of the narrative; they will have to look elsewhere for clear maps.

This splendid book is a call to action. “If we learn from the past, understand the present, and imagine a better and more sustainable future,” McMichael tells us (p 279), we may yet trigger both morality and latent sparks of genius, to “ignite corrective action and light the path to a sustainable way of living on a finite planet.” And if we are successful, as we must be, Tony McMichael’s contributions will live on as a vital part of that legacy.

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REFERENCES


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Aspirational Statement from the One Health Ecohealth 2016 Congress in Melbourne, Victoria

Towards a Healthier Future Through Converging Communities of Inquiry and Practice

This document was prepared by Emerging Scholars and Practitioners on behalf of the multiple communities of inquiry and practice working at the convergence of human, animal, ecosystem and planetary health.

PREAMBLE

The One Health EcoHealth (OHEH) 2016 Aspirational Statement is a document created for the OHEH Congress that took place in Melbourne in December 2016. It sets out the aspirations of Emerging Scholars and Practitioners located within communities of inquiry and practice working at the intersection of human, animal, ecosystem and planetary health. It is towards a collective of diverse communities capable of imagining and manifesting a radically sustainable future to which we aspire. The aspirations outlined here represent the values and principles we feel are needed to orientate our efforts towards this task. At the heart of this document is a firm belief that out of diversity come strength and resilience, and that a collective of communities rooted in these ideas is stronger and more effective than the sum of its individual parts.

WHY NOW?

In recent years, numerous fields of inquiry have emerged recognising the complex connections that exist between human, animal, ecosystem and planetary health. Fields such as Conservation Ecology, EcoHealth, Ecological Public Health, Environmental Health Justice, Environmental and Occupational Health, Human Ecology, OneHealth, Planetary Health and Sustainable Development, among multiple others, are agents of the growing ecology-health nexus. Whilst recognising these fields have emerged from diverse knowledge philosophies, the expansion of this area of inquiry and practice speaks to an increasing recognition of the complex interdependencies that exist between the social, physical and planetary dimensions of health. This, in turn, is giving rise to a convergence of ecologically informed health-related research and practice. We understand that such ways of conceptualising health are rooted in ancient and diverse ways of knowing. This is outlined in key United Nations documents such the Declaration of Rights of Indigenous Peoples.

That such a convergence is occurring now is, perhaps, to be expected. Environmental science indicates that we will be the first generation of human beings to knowingly step into a new geological era. Receding before us is the Holocene—an 11,000-year-old period of extraordinary environmental stability that gave rise to societies of increasing social complexity. Looming in front of us is the Anthropocene—the era of humankind. The Anthropocene metaphor, one of several explanations for the need for transformational change, comes at a time when human influence upon the Earth rivals’ natural processes in shaping the evolutionary trajectory of all life. We recognise that our collective actions have fundamentally disrupted the biophysical processes that underpin ecological stability, pushing earth systems beyond a safe operating space for humanity and into an uncertain and largely unknowable future.
This ‘field convergence’ will present opportunities and challenges for scholarly and practice-based communities alike. In response, the purpose of this Aspirational Statement is to chart a direction for our respective fields and communities of practice in the context of increasingly overlapping scholarly terrains, based on our shared goals, values and aspirations. The aim is not to deliver a ‘roadmap’ with a specific destination, but rather to articulate a broad set of principles that may help us to create a more equitable, positive, healthy and sustainable future for all life.

This Aspirational Statement is about ‘transformational change.’ Current ways of doing health research and practice need to evolve if we are to address the major human-environmental health issues confronting us in the Anthropocene era. In order to disrupt existing paradigms that have produced many of the challenges associated with the Anthropocene, we believe that we must occupy new and uncomfortable spaces, and commit to bridging disciplinary and practice-based divides to innovate and activate a global consciousness for collective action. Moreover, we hope this Aspirational Statement will inspire a new generation of scholars to take up the complex challenges before them, while encouraging our Elders to provide the mentorship that is supportive of the aspirations outlined in this document. We believe the following principles and values are fundamental to these change efforts.

**WHO IS THIS STATEMENT FOR?**

This document is for anyone interested in and inspired by connections between animal, human, ecosystem and planetary health. It is for those who are motivated by a sense of urgency for the state of living systems on the planet, and those who see transformational systems change as paramount to addressing the challenges before us.

**OUR PROCESS**

A group of emerging scholars and practitioners were motivated by their Elders to develop an aspirational statement speaking to the increasing convergence of actors, institutions and disciplines converging on issues of human, animal, ecosystem and planetary health. Prior to and throughout the OHEH 2016 Congress, an invitation was extended to delegates to articulate what they aspire to achieve in their work, which was subsequently shared with global communities operating in this space for feedback.

This is a living document to be revisited as our collective communities continue to evolve.

**Aspiration 1: Negotiating Shared Identity**

We aspire to be a collective of communities that are courageous, curious and compassionate. As individuals and communities respectful of our diverse identities, we recognise that we are connected to each other and to the places that nourish us. From this understanding, we aspire to connect across and celebrate our differences. By listening and hearing from people, places and living systems fundamental to our collective well-being, we will continue to negotiate a shared sense of identity capable of driving collective actions towards sustainability.

**Aspiration 2: Leveraging Shared Values**

We aspire to foster and act upon our shared values that include equity (intergenerational, intra-generational and interspecies), diversity, openness, responsibility, sustainability, accountability and respect for the people, places and processes that sustain life. Our values drive our actions, shape our ways of knowing and inform who we are.

**Aspiration 3: Strengthening Collaboration**

We aspire to address wicked social–ecological challenges through collaboration. We want to create opportunities to collaborate and to reach out to others who share our aspirations. We want to facilitate understanding across cultural and community divides, and to cultivate a common language from which we may work together. We are interested in creative ways to achieve transformational change, drawing on science, technology, the arts and diverse ways of knowing/being. We recognise that power naturally arises in our collaborative work. We commit to acknowledging and naming that power, particularly when it adversely affects processes of working with one another for change.

**Aspiration 4: Integrating Knowledges**

We aspire to embrace the complexity of our world, while recognising that our knowledge is only ever partial and open to interpretation. We recognise multiple legitimate ways of knowing, and we aspire to be open to diverse knowledge systems before harnessing their creative and transformative potential. Our knowledge is informed by our lived experi-
ences tied to the places in which we live, play and love, as much as it is by globalised ways of knowing.

**ACKNOWLEDGEMENTS**

This aspirational statement was prepared by Emerging Scholars and Practitioners on the behalf of the multiple communities of inquiry and practice working at the converging intersection of human, animal, ecosystem and planetary health. We would like to thank everyone who participated in the process of drafting this statement, and especially to thank our elders for creating space for this discussion at the OHEH Congress in Melbourne, Victoria, December 2016.
Cover Essay
Bunjil’s Charge

To heed the lamentations of the world,
concerning how what was immortal dies
and learning where such death lies hid and furled,
we read the burning whispers of its sighs;
to tend a course that sails and quickens us
toward spurning unity in all we see,
we rend the source that ails and sickens us
from churning pith from possibility—
accede, and seas will cease their seizing crest
when yearnings for a turning Dreamtime Pax
concede the weeds of reeds as our behest:
like stars astern discerned as parallax
impearled, from eye to hand, our charge is hurled
to heed the lamentations of the world.

Mark Olival-Bartley
ABOUT THE POEM AND THE POET

Written for One Health EcoHealth 2016, this sonnet acknowledges the people of the Kulin nations as the traditional custodians of the land where the congresses were held and celebrates their indigenous knowledge: For millennia, the story was told of how Bunjil, the creator god taking the form of a wedge-tailed eagle, watched over his people, who had lived in harmony with the Earth; when they began to fight and neglect their responsibilities, chaos ensued, and the seas rose—desperate, they appealed to Bunjil, who agreed to save them only if they promised to return to their earlier ways. The Greek epigraph reads “one is all” and comes from the Chrysopoeia of Cleopatra, a third-century manuscript expounding the ouroboros, the serpent of Egyptian iconography eating its own tail, as a symbol of the cyclicality of life. The reprise of the first line as the last—to say nothing of the poem’s rhymed refrains—further echoes the uncanny prescience of this cautionary tale. Further inspiration came in the form of the congresses’ logo, a pair of hands folded into an aquiline form of flight above the globe, and Bruce Armstrong’s Eagle, which stood in silent vigilance over the proceedings in Docklands, a stone’s throw from the venue.

The resident poet at EcoHealth Alliance, Mark Olival-Bartley, is presently anatomizing the sonnets of E. A. Robinson for his dissertation at Amerika-Institut of Ludw-Maximilians-Universität München, where he tutors composition and poetics, and assembling Chimera, a collection of his verse and translations.

ABOUT THE ART AND ARTIST

Melbourne artist Bruce Armstrong is best known for his monumental totemic sculptural figures installed in public spaces around Australia. Often carved from large pieces of red gum or cypress, his birds, beasts, and hybrid mythological creatures have an intense energy that have a dominant presence and engage the viewer directly (Hurlston and Gott 2016). Armstrong has a firm belief that humans’ connection with the animals and nature is a vital way of interacting and understanding with the world.

Armstrong has worked as an artist since graduating from RMIT University, Melbourne, in 1981. While he is known most as a sculptor, he works across different media, including painting, drawing, and printmaking. He has combined an attraction to rough timber with his interest in painting to create a number of portraits of animals and people on wooden panels.

Some of Armstrong’s notable works include Guardians, which flanked the entrance to the National Gallery of Victoria’s St Kilda Road building from 1987 until 1999, and his twenty-three-meter high Eagle, 2002, located in the Docklands precinct of Melbourne, as seen on the cover. Adopted by the community as a symbol of the Indigenous creator spirit Bunjil, this work has become a much-loved Melbourne icon.

REFERENCE