



Environmental Aspects of Zoonotic Diseases

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Preface

“We are a cluster of molecules trying to comprehend themselves”

During my “Sabbatical” year at ESR (Environmental Science and Research Institute) in Christchurch, New Zealand, I was startled by the small population of this country (~4.4 millions) and the huge sheep population (~40 millions) both inhabiting the two islands of this country. While discussing different environmental issues with my colleague and host, Dr. Marion Savill, I wondered if such a massive ratio of domestic animals to humans does not reflect itself in water and environmental pollution and consequently in high numbers of zoonoses. Further verifications, revealed that indeed New Zealand has a high prevalence of Campylobacteriosis, a consequence of this country’s vast numbers of free-grazing sheep. A brief look at a dataset published by the from Ministry of Agriculture and Forestry (NZ), according to reports for the year 2007, the country domestic animal inventory was (in millions): ~6 dairy cattle, 1.4 deer, 38.5 sheep, 0.4 pigs, 0.1 goats, 0.066 horses and 19.8 poultry. While preparing myself for the one year visit, I gained knowledge of some facts about this remote country such as, its area size is close to that of the UK and even larger (Table I). As a consequence, I decided to link some numerical data for comparison. The ratio of animals per person (animal density) in New Zealand is 6.25 higher than in the UK (in spite of there being almost twice as many animals in the UK!) and zoonoses are ~6.1 higher. These two countries have two important and comparable parameters that help in such an assessment: area size and ethnical similarity. Recently, Kabore *et al.* (2010) evaluated the association of potential zoonotic gastroenteritis in children (e.g., giardiasis, salmonellosis and campylobacteriosis) with environmental risk factors (livestock densities and drinking water quality) in rural Quebec (Canada). Using statistical tools (negative binomial regression models accounting for overdispersion and adjusted for clustering) the authors found that all three zoonoses were significantly correlated to animals density. In addition Giardiasis incidence was also positively associated with poor drinking water quality (without a statistically significant association). Snel *et al.* (2009) using a simple linear regression model, analyzed ten years of giardiasis cases in New Zealand (rural and urban cases) to find whether an association between disease rates and animal density exists, at the territorial authority level. Their results did not reveal a significant correlation between giardiasis and farm animal density at this level. Their explanation

of the nonsignificant results was that giardiasis distribution is largely linked to anthroponotic (human) reservoirs and much less to zoonotic sources in rural environments and to contributions from overseas travel. It should be borne in mind that giardiasis is mainly a waterborne disease and zoonotic to a much smaller degree. Nonetheless, the same authors (Snell *et al.*, 2009), using the same simple linear regression model, analyzed ten years of cryptosporidiosis cases in New Zealand (rural and urban cases) to find whether an association between disease rates and animal density exists, at the territorial authority level. This time they reported a significant correlation between farm animal density and cryptosporidiosis, with much higher rates in rural areas. In this case, the results supported the fact that the *Cryptosporidium* parasite is mainly zoonotic (transmitted from farm animals to humans) and animal density is indeed a significant risk factor as already pointed out by the Canadian study and our number manipulations!

Table I. Some data related to domestic animals, country area, population and zoonoses in two countries (UK and New Zealand) (based on 2007 data from both countries).

Animal	New Zealand ($\times 10^7$)	UK ($\times 10^7$)
Cattle	6	5.5
Deer	1.4	0.002
Sheep	38.46	14.2
Pigs	0.36	3.6
Goats	0.11	0.069
Horses	0.06	0.2
Poultry	19.8	125
Total	66.19	148.57
Population	4.4×10^7	62×10^7
Country area size	268,021 km ²	243,610 km ²
Ratio-animals/human	15	2.4
Ratio-animals/area (No./km)	2470	6098
Reported zoonoses (year)	518.100 (2009)	84.989 (2009)
Zoonoses ratio between NZ/UK	6.096	
Animals/human ratio between NZ/UK	6.25	

In light of these basic data, we raised an important question that had troubled us for a long time: OK, the natural situation is as it is but how do we, human kind, by our “continuous development prerogative”, and unpreventable natural disasters (e.g., earthquakes, floods, draughts, global warming, tsunami, etc.) jointly impact zoonoses? The present book is a result of over 2,000 scientific publications collected, sorted and critically explored to accomplish the interesting and stimulating depiction of the various relationships between environment, anthropogenic environmental intervention and zoonoses. We are very grateful to the meticulous and comprehensible book “Zoonoses- Infectious diseases transmissible from animals to humans” (3rd edition) edited by Krauss *et al.* (2003) that helped us to navigate systematically our way through such a huge mass of zoonotic pathogens.

We would like also to thank our families and students for their indulgent patience and to apologize for the unjustified absence when they needed us as a consequence of our passion for this fascinating topic.

Robert Armon and Uta Cheruti,
Technion, Haifa, 2011

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Brief CV of the authors



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Prof. Armon was born in Bucharest, Romania. He studied Biology (B.Sc.) and Environmental virology (M.Sc.) at Hebrew University of Jerusalem, Israel. He earned his D.Sc. in Environmental virology from the Faculty of Biotechnology and Food Engineering (Technion, Haifa, Israel). Post-Doctoral studies followed at University of Rhode Island, USA (one year) and Institut Armand-Frappier, University of Québec, Canada (two years). Since 1994, is a faculty member of Civil & Environmental Engineering Faculty at Technion (Israel Institute of Technology, Haifa, Israel). Prof. Armon is teaching Environmental Microbiology and carries research on related issues in this area. He published over 84 scientific publications in peer-review international journals, wrote different chapters in several books and is a member of various international scientific organizations (IWA, HRWM, ISEI, ASM, etc.).



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**“Tanto sa ciascuno, quanto opera”*
[Ones knowledge is built upon his industriousness]

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*Bartolommeo Aquarone (1857) “Vita di Fra Jeronimo Savonarola”. LIBRO SECONDO

*Pasquale Villari (2006) “La storia di Girolamo Savonarola e de’suoi tempi”. Vol. 1, Elibron Classics Series.

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Chapter 1

Introduction
