

# Thoughts of a Travelling Ecologist 1

## Human impacts, invasions and urbanisation

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At the start of our new *Journal of Biosafety*, I was prompted by my Co-Editors-in-Chief, Professor Wan and Professor You, to provide regular reviews or updates on biosafety for our readers, given that I mostly reside outside China, and have many international connections. That is a very big task, and I was not sure that I could do it as the journal demands. However, I had thought that in a lighter way, I could attempt to present my thoughts on some issues that I feel are of importance today. China is very quickly opening to the world, economically, scientifically, and in many other fields, and for many colleagues inside and outside China, this is a new situation. During my career, I have worked in several countries of Europe, in New Zealand, and had projects on other continents. This gave me experiences in different parts of our globe, and I feel that all of us, ecologists, have to start thinking more widely, and be aware of developments, especially of human impacts, on faraway places. So my view when writing these essays will try to be both local and global. Therefore I have chosen the overall title for this series of essays “Thoughts of a travelling ecologist”. Below you will be able to read the first one—I hope you will enjoy them. If you feel like to add, or comment on my essays, please feel free to do so. Any feedback will be most welcome.

Humankind has become a global force transforming the Earth. With increasing sophistication of analyzing large datasets, our impact on all life of Earth is becoming quantified. The Millennium Ecosystem As-

essment made several of these statistics widely available (MEA, 2005):

– For example, more land was converted to cropland in the 30 years between 1950 and 1980 than in the 150-years period between 1700 and 1850.

– By 1990, more than 2/3rd of the area of two biomes (temperate forest, tropical dry forest) and more than half of the area of four others had been converted.

– Another crucial resource, freshwater is also increasingly appropriated by humans. The amount of water in reservoirs quadrupled since 1960, and they now hold 3 ~ 6 times more water than the total flow of all natural rivers.

– The application of synthetic fertilizers have doubled the biologically available N, and tripled that of phosphorus in terrestrial systems since 1960.

These effects are also typically accelerating: for example, more than 50% of all the synthetic nitrogen fertilizer ever used has been used since 1985. 60% of the increase in the atmospheric concentration of CO<sub>2</sub> since 1750 has taken place since 1959 (MEA, 2005).

Urbanisation is one of the powerful nature-transforming processes. Sometime during 2009, humanity passed the threshold of having 50% of all people living in urbanized areas (UNPD, 2005). Life in urban areas and humankind's relationship with it is becoming important for several reasons. Urban areas are not devoid of life, and are very rich in resources (Gaston *et al.*, 2005)—so they provide important living space for

nature. Urban areas are concentrations of resources, and the majority of these are imported from outside (“the ecological footprint” of cities, Girardet, 2004). A consequence is that urban areas are often hotspots for invasions, for several reasons:

People’s travelling and shipping of resources from one part of the globe to another is an important driver of invasions (Essl *et al.*, 2011), and this flow of goods (and potential invaders with them) is increasing, as the globalization of economic activities is more and more advanced. This increases invasions—China is a good example (Lin *et al.*, 2007). Additionally, in urbanized areas, native species are often eliminated, and conditions may favor non-native or invasive species.

Urban areas can also serve as “incubation locations” for invasive species, especially under global change. Newly arrived, founder individuals have to run an unknown (but supposedly large) risk of extinction due to random factors or extreme events. The effects of many extreme events are expected to be more cushioned in urbanized environments than elsewhere. Urban areas often provide more benign climatic conditions, fewer extremes of these climatic conditions, are free of natural enemies, and provide ample resources. Due to one or more of the above factors, arriving organisms have fewer problems to cope with than in more natural areas of the same region, and can concentrate their own energies on adapting to their new environment.

Due to the above factors I believe there is much to gain from linking urbanisation and invasion studies. There are now methods available to measure the intensity of a number of ecological functions and the general suitability of the environment.

Traditional studies of urbanisation concentrated on species presence, diversity and similar assemblage-level parameters. However, more sensitive ones, including those of behavior (Luan & Liu, 2011), body condition, or changes in immune condition can all characterize the friendliness or unfriendliness of an environment, and are suitable to test several hypotheses. We can expect that invasive species in general find more stressful conditions outside cities, and this would reflect in at least some of the above characteristics. We can test if cities indeed serve as invasion hotbeds,

by measuring the diversity of invaders in urban vs. non-urban settings. We can check if species become more or less variable once they leave city boundaries. These are all interesting research areas, possibly yielding important insights into the importance of urbanized areas in invasion dynamics.

Therefore there is considerable weight behind the suggestion that linking urbanisation & invasion studies will bring benefits to our understanding and management of biological invasions, an important element of global change (Vitousek *et al.*, 1997).

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