Ecosystem Health and Sustainable Agriculture

Ecology and Animal Health

Editors: Leif Norrgren and Jeffrey M. Levengood
Habitat Fragmentation

It is well established that habitat fragmentation reduces overall species diversity and alters species abundance (Laurance and Bierregaard, 1997; Ferraz et al., 2003), often with cascading effects on ecological processes and community structure (Crooks and Soule, 1999; Cordeiro and Howe, 2003). An important aspect of this is how habitat fragmentation alters the way in which hosts and pathogens interact, and how this affects the ability of the host to survive and prosper.

Habitat loss is one of the most important threats to global biodiversity. Modifications to habitat result in both reduction in size and fragmentation. Understanding the ecological importance and conservation value of fragmented landscapes is vital for wise management. Management of small patches of habitat is an opportunity to make important conservation gains, particularly for species with occupancy areas that do not encompass a protected area. For the aforementioned reasons, the study of habitat fragmentation is an active field of inquiry in conservation biology (Laurance and Cochrane, 2001). Studies include investigations quantifying changes in the physical environment (Kapos et al., 1997), experiments ranging from the micro to landscape scale (Debinski and Holt, 2001; Laurance et al., 2002), metapopulation approaches (Hanski and Gilpin, 1997; Lawes et al., 2000), and field studies in fragmented habitats (Laurance and Bierregaard, 1997). These studies have yielded valuable insights into the importance of fragment size, shape and isolation on ecological processes and species survival probabilities.

Much of the previous work on fragmented habitats has involved fragments protected from human use (Lovejoy et al., 1986; Tutin et al., 1997; Tutin, 1999). In reality, most fragments are not protected and are characterised by open access to private citizens, who depend on them for fuelwood, medicinals or bushmeat. Thus, fragments change in structure and composition as landowners use the forest for grazing or to extract timber or fuelwood or allow fallow land to regenerate. Although studies in protected reserves have provided us with many insights, they may have biased our perception of the long-term value of fragments.

Emerging infections pose a threat to global human health that is equal to the threat they pose for wildlife conservation. Novel infectious diseases are emerging today in human populations at an accelerated rate worldwide, and the trend shows no signs of abating. Microbes thought to be on the brink of extinction decades ago remain tenaciously endemic, both because of gaps in surveillance and because the pathogens themselves have shown a surprising ability to evolve. Pathogens such as HIV, West Nile virus, SARS coronavirus and influenza virus emerge and re-emerge with disquieting regularity, in some cases causing epidemic or pandemic mortality. Globalisation, climate change and increased contact with reservoir species through agricultural intensification and natural resource exploitation all drive this trend (Daszak et al., 2000; Daszak et al., 2001; Woolhouse and Gowtage-Sequeria, 2005).

Although humans have always shared habitats with wildlife, the dynamics of human-wildlife interactions
Infectious Diseases at the Wildlife-livestock Interface

have changed dramatically in the recent past. Within the last few decades, humans have altered wildlife habitats irrevocably, disturbing ecosystems as the material and economic needs of expanding human populations grow. Today, wildlife lives in habitat mosaics of farmland, human settlements and forest/grassland fragments, and in isolated protected areas such as national parks. Human influences in the form of roads, hunting and climate change are reaching even into the last remaining ‘strongholds’ of biodiversity. Infectious disease emergence is an unfortunate and unanticipated consequence of these ecological changes.

**Species Barriers**

Indeed, a full 75% of emerging human infectious diseases are zoonotic or have recent zoonotic origins, with diverse wildlife taxa, livestock and domestic carnivores serving as common sources of infection (Taylor et al., 2001). Comparative epidemiological analyses indicate that an ability to cross any species barriers actually enhances the probability that a pathogen will be classified as ‘emerging’ (Cleaveland et al., 2001; Taylor et al., 2001; Woolhouse and Gowtage-Sequeria, 2005). This realisation, combined with a sense of urgency about anthropogenic environmental change, has spawned a series of new disciplines bearing such names as ‘conservation medicine’ or ‘ecosystem health’, complete with dedicated societies, journals and international meetings (Daszak et al., 2004).

The process by which pathogens cross species barriers and eventually cause persistent health problems involves a complicated series of steps, each with its own (usually low) probability (Wolfe et al., 2007). For example, diseases that find their way into new species do not always possess the ability to spread within that new species, and diseases that can spread within a new species sometimes fail to perpetuate. Nevertheless, the initial ‘jump’ from one species to another is the critical step, since interrupting the process of transmission between species eliminates the possibility of any ‘downstream effects’. Domestic animals can play a critical role in enhancing wildlife-human disease transmission. Dogs, for example, may serve as intermediate hosts for the transmission of blood-borne viruses and parasites to the humans who own them.

The Baltic and Great Lakes areas share a similar propensity for mesopredator release. Crop raiding is another ‘risky’ behaviour that may increase infectious disease transmission. To raid crops, animals must often cross pastures, dodge chained dogs and packs of roving dogs, and avoid being injured by farmers or their children who guard crops actively. Importantly, results to date indicate that direct contact between species is not necessary for interspecific disease transmission. Indeed, most transmission of gastrointestinal pathogens between people and wildlife is probably indirect and environmental. Pathogens such as *Cryptosporidium*, *Giardia* and *E. coli* readily contaminate water and soil and may persist in wet areas. Human, wildlife and domestic animal contact with common environmental sources of infection may explain many of the trends.

**Conclusions**

If human behaviour is indeed a strong force influencing the transmission of pathogens between wildlife and people, then targeted interventions should be possible. Making people aware of the disease-related risks of their activities, and providing alternatives, could go far towards reducing interspecies disease transmission and improving human health, animal health and wildlife conservation. Only with a detailed ecological understanding of how human behaviour alters the dynamics of disease transmission among wildlife, people and domestic animals can we design rational intervention strategies that contribute efficiently and effectively to animal and public health and conservation.


Chapter 24


**Chapter 25**


Aubert, M.1995. Epidemiology and campaign against rabies in France and in Europe. In: *Bull Acad Nat Med*. May; 179(5), pp 1033-54


EFSA 2009. 2 Porcine brucellosis (Brucella suis), Scientific opinion of the Panel on Animal Health and Welfare (AHAW) on a request from the Commission on Porcine brucellosis (Brucella suis). In: *The EFSA Journal* (2009), 1144, 1-112


Holmgren, N. and Lundheim, N. 1994. The therapeutic need of medicated feed in Swedish piglet producing herds (Swedish). In: Svensk Veterinärtidning 45 pp 57-64

