



Science

THE ECOLOGICAL HOSTS SHIFT OF PARASITES AND THE OUTBREAK OF EMERGING INFECTIOUS DISEASES: A REVIEW



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Abstract

Parasites are organisms which metabolically depend upon their hosts. To understand the ecological host shift of a parasite, it is important to look the host-parasite associations with respect to ecological change and factors that generate, maintain, and constrain the associations with implications for a wide range of ecological issues, including the dynamics of emerging infectious diseases. Although, the ecological significance of parasites is almost overlooked for several years by ecologists, considerable efforts are being made to understand their functional importance in ecosystems. Parasites play vital role in the trophic cascades of the food web. Environmental change caused by anthropogenic activities result host shift of specialist parasites and this shift of specialized parasites can rapidly to new hosts via ecological fitting play an important role in the ecology and evolution of host-parasite associations. This condition is the primary cause for the Emerging Infectious Diseases when parasite species begin infecting and causing disease in host species with which they have no previous history of association. Therefore, understanding the host parasites interaction and distribution of known and potential pathogens is a vital precondition for optimizing their positive, while minimizing their negative effects on conservation, restoration and sustained development programs.

Keywords: Emerging Infectious Disease; Host; Host Shift; Parasite.

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1. Introduction

Parasites are organisms that metabolically depend upon their hosts for essential resources. They require their host not only for obtaining nutrients, but also used as physical support for the completion of their life cycle (Poulinet al., 2011). These organisms include insect herbivores, microbial pathogens endo and ecto parasites.

Now a day with the change in the global climate which is caused by human activities the overall ecological impact of the parasites is more magnified. They are producing devastating effect on human survival and affect human livestock, crops, and wildlife faunas and floras. But in a normal ecological function they are integral components of the biosphere (Horwitz and Wilcox, 2005). As a result they are now become evolutionary paradox that they either control host populations, serving to maintain the genetic diversity and structuring of communities in the ecosystem or they may represent threats to: human health, agriculture, natural systems, conservation practices and the global economy through interactions such as faunal disruption and ecological release. This situation creates the controversial idea for most ecologists and parasitologists and produces powerful paradigms of parasites in ecology and in evolutionary biology. As a result the role of parasites in different biological processes such as host population regulation and disease virulence should be realized. The effect of an environmental change can affect the parasitic interactions for both members of the association. Thus, the survival of parasites from environmental change will be determined by several factors such as host dependence and parasitic specificity, the complexity of the life cycle, the biodiversity of the environment, the density and mobility of their hosts and the physiological tolerance of individuals (Martinez and Merino, 2011).

Therefore, with increase in anthropogenic activities which result the alteration of environmental conditions can have an adverse effect on availability of resources necessary for hosts to maintain an adequate nutritional status. In this case hosts do not have the ability to exploit other resources and their health seriously compromised (Morgan, 2009), and their immune competence could be reduced thereby facilitating settlement and reproduction of parasites. This situation favors the ecological demerits of the parasites (Merino, 2010).

1.1. Objectives

The overall objective of this review paper was to access how the ecological host shift of parasite would happen and its implication to the outbreak of emerging infectious disease.

2. Ecological Significance of the Parasites (ecological merits and demerits)

Even if the ecological roles of parasites are almost ignored for decades in the past by ecologists, considerable efforts are being made to understand their functional importance in ecosystems. Currently the study of host-parasite interaction during environmental assessment should highly encourage in order for appreciating the functional importance of the parasites in ecosystems and Parasites serve as ecosystem engineers modifying the environment of other organisms directly or indirectly (Horwitz et al., 2005). They may serve as keystone species and give trophic information and play a role in bottom-up or a top-down cascade effect of food web. They are indicators of species diversity in a given ecosystem. Similarly, parasites are also indicator of climate change and pollution which can affect the entire biodiversity in the ecosystem. Thus Ecologists and conservation biologists are now tried to show that the introduction or elimination of a parasite in an ecosystem can affect the interactions of organisms (Kuris, 2008). Parasites influence host genetic diversity and co-evolutionary processes change species composition in ecological communities parasite-mediated apparent competition. Parasites pose threats to the health of humans and even deaths of millions of people per year.

Parasites can enhance the flow of energy; alter the strength of interactions, change productivity and cause trophic cascades and the addition of these infectious agents in this fundamental ecological concept might allow for a better understanding, evaluation and mitigation of human impacts on ecosystems, including biodiversity loss, climate change, exotic species, pollution, bioremediation, pest control and fishery exploitation (Ross, 2005).

Although, parasite establishment and spread should be greater in large host populations, small or endangered host populations might experience unusually large impacts from infectious diseases owing to limited genetic variability or threats from generalist parasites and it is now obvious that pathogens can cause major shifts in the genetic composition of their hosts on short timescales and host genetic diversity can play an important role in buffering populations against widespread epidemics (Daszak, 2003).

The connection between community structure and parasite incidence has a broad ecological and evolutionary significance. Changes an ecological scale, results in change disease epidemiology and host community structure are expected to occur in multi-host parasite systems. These systems also have important implications for practical issues and in crop and animal sciences, biological control, pest outbreaks and invasions are promising tools or increased threats that a sustainable agriculture will have to manage (Smith, 2009).

2.1. How can Ecological Host Shift Happen?

Under normal ecological circumstances the ecological significance of parasites is almost balanced. However, with the change in the environmental condition which are highly induced by anthropogenic activities, for instance, the feeding habit, the reproductive potential of that organism as well as their interaction with each other and with their ecosystem is changed dramatically or those parasites which are adapted only for a specific resource are forced to utilize a wide range of resources which are not previously related resource. The ecological host shift can be manifested by the change of specialist parasites to generalist which are resource specialists with restricted host ranges, and yet shifts onto relatively unrelated hosts and these are common in the phylogenetic diversification of parasite lineages and directly observable in ecological time (Agosta et al., 2010).

Most parasites have evolved to be resource specialists. However, the specialist nature of the parasite happen in favor of the plenty availability of the environmental resource i.e. food. In other words, host specialization leads to evolutionary dead-end where parasites cannot adapted to their hosts at the expense of the ability to perform on alternative hosts and many groups exhibit higher transition rates from generalization to specialization, but host specialization appears to be a dynamic trait with no inherent necessary directionality (Nosil & Mooers 2005). Colonization is the starting point of every host shift, during which the parasite should retain the capacity to use both the ancestral and new host. Multiple host use following such colonization may be brief or it may be prolonged (Homles and Price, 1980) but host shifts must begin with a host range expansion. Initially, additional hosts should typically be inferior alternatives to the original host, to which the parasite is specifically adapted, and special circumstances should be needed to incorporate such a host into the range. Yet, host shifts and host range expansions do occur, and can happen rapidly.

Ecological and macro evolutionary evidence for ecological fitting among hosts and parasites suggests that host shifts are often initiated because the parasite is expected, or readapted to the new resource. The new host might share important characteristics with the current host or might have been used in the past (Brooks, 2003).

2.2. The outbreak of Emerging Infectious Diseases

Emerging infectious diseases (EIDs) are infections that have newly appeared in a population or are rapidly increasing in incidence or geographic range. Many of these diseases are zoonoses and include avian influenza, severe acute respiratory syndrome, hemolytic uremic syndrome and human immunodeficiency virus/acquired immune deficiency syndrome HIV (Brooks and Ferrao, 2005). Currently, the general trends of the Emerging Infectious Diseases are highly noticeable since they are highly dynamic agents with environmental disturbances that means these ecological, or Environmental factors plays a critical role for the transfer of these infectious agent by increasing contact with the natural host for a previously unrelated zoonotic agent (Daniel et al., 2006). The change in ecological variables in the ecosystem may affect the organisms feeding strategy.

As result organisms specifically parasites are forced to shift their original host through ecological fitting to new hosts and these trophical shifts of organisms particularly parasites induce: undesirable effect on the newly shifted relatively unrelated hosts (Agosta et al., 2010). Generally, Emerging Infectious Diseases are occurred when Parasite species start to infect and causing disease in host species with which they have no previous history of association (Daniel et al., 2006)

2.3. Interconnectedness of Climate Change, Biodiversity and Emerging Infectious Diseases

The rapid growth of human population results the degradation of ecological services. Introducing humans and other species into new regions of the biosphere accelerates land-scape alteration and ecological perturbation, which in global ecosystems can initiate events that link climate change, loss of biodiversity and facilitates the occurrence of Emerging Infectious Disease (Brooks and Ferrao, 2005). Such events include increased biotic mixing of evolutionarily unfamiliar species, and therefore increased opportunities for parasites and pathogens to find and infect and whether we adapt successfully to these changes depends on how we develop and apply knowledge about the responses of parasite systems during episodes of climate change.

3. Conclusion and Recommendation

Ecological host shift of parasites caused by environmental change often produces undesired effects on human and biodiversity. Similarly, the potential increase of extreme climatic events can destroy or pose important difficulties for development and implement of any measure to control the extent of diseases. Therefore, socio-ecological system and the anthropogenic factors should be considered to mitigate and take prevention measures to control and eradicate potential epidemic diseases. Different epidemiological approaches and Ecological management strategies should be implemented to determine, identify and mark the major causes of Emerging Infectious

Diseases and to control their spread. One of the approaches is increasing surveillance for known pathogens and to identify previously unknown infectious agents. Besides, recent studies should give emphasis into the ecology, pathology, and population biology of host-parasite systems from individual, population, and environmental perspectives.

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