# The Use and Mis-use of some Ecological Terms and Concepts in Epidemiology

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*The article discusses the current use and mis-use of ecological terms and concepts in epidemiological literature, and in special, in works dealing with zoonotic diseases. A selection of examples was taken from papers recently published on the transmission of Chagas' disease by* Triatoma sordida. *Proper definitions are listed, with the intent of helping non-ecologists to use those terms and concepts correctly.*

Key words: *Triatoma sordida* - ecology - Chagas' disease - epidemiology

Epidemiological literature has been suffering from the use of ill-formed ecological concepts, and the mis-use of terms currently used in ecology.

The investigation of zoonotic chains, involving non-human hosts and reservoirs, vectors and human hosts is complex, and it must draw upon the disciplines of ethology, animal behaviour, systematics (including taxonomy), ecology, evolution. Free use of concepts and terms in a rather loose fashion contribute to inaccuracy of meaning and confusion of issues.

A selection of such terms will be analyzed, on the basis of current literature on Chagas' disease.

The novice trying to find his bearings among the enormous amount of published data on this disease, will be bewildered by some fundamental contradictions, not only when he compares the opinions of different authors, but also within a single article.

I selected one species, *Triatoma sordida*, as a case study.

The discrepancies are due mainly to the interpretation of existing data, and to inaccuracy in the use of certain terms and concepts. Some assumptions are gratuitous, with no basis on actual observation, verification, or experiment.

## A CASE STUDY

It has been predicted that *T. sordida* could fill the niche of *T. infestans*, after the implementation of a control program in the State of São Paulo, to eradicate this species. The October-December 1993 issue of *Cadernos de Saúde Pública* (vol. 9 nº 4) published three articles on Chagas' disease. The references to ecological aspects of *T. sordida* were analyzed as a case study.

Marsden's (1993) outstanding review of facts concerning medically important arthropods in Brazil summarizes the current knowledge of the role of *T. sordida* as a potentially important vector, as revealed by the Mambaí Project, and uses ecological terms correctly:

*...this has been a common species in chicken coops, with an increasing tendency to invade households. It has been captured in the virgin* cerrado *and clearing of this to make cattle farms may force it into houses. Since it shows an apparent preference for chicken blood this must explain its very low* T. cruzi *infection rate (<1%). In Mambaí it is a low risk vector, in spite of house colonization. ...*

Coura's (1993) objective and pertinent analysis of the false dilema of vector control *versus* house improvement though, lists *T. sordida* among those few species which are important for the transmission of the infection to man. Its great importance is ascribed to its ubiqüity, living in the peri and intradomicile, *e também possuindo uma grande capacidade de reinvasão domiciliar, como é o caso de* sordida, *o mais importante dos "vetores secundários" (Forattini 1980, Forattini et al. 1983)*[in Portuguese in the original]. Coura's (1993) use of terms and concepts in this paper is also adequate.

Wanderley (1993), on the other hand, tries to correlate the pattern and rate of progressive deforestation of the State of São Paulo with changes in the ecology, distribution, and epidemiological role of the vectors. Stronger evidence is needed to show this correlation to be true. When such a large

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number of variables is involved, it is risky to conclude that a simple chronological correspondence can be interpreted in terms of cause-and-effect, or else, as a correlation of independent and dependent variables. Many contradictions and false correlations in her analysis show how pseudo-ecological claims contribute to cloud an already unclear picture.

Concerning *T. sordida,* a comparison of the available data on captured triatomines shows that *between 1953 and 1963 there was a decline of 4.2 percentage points in the number of naturally infected* T. infestans. *Meanwhile, a significant presence of* T. sordida *was observed...* This is confusing, as there is no reference to the rate of infected *sordida* found, either before or after 1963.

From 1962 to 1973, *in the* clean *areas, free of* T. infestans, *the two other main species of triatomine* -T. sordida *and* P. megistus - *continued to be found...* The explanations used to explain this facts are contradictory, as the following statements show:

*Overall, this species [*sordida*] is fairly distributed ... owing to its relatively extensive ecological adaptability, which allows it to frequent a variety of ecotopes, many of them with a poor supply of potential food, but with a considerable scope for reproduction....*

*...However, in regions where the land is frequently worked ... a progressive decline in the presence of this native species has been observed, probably as a result of a reduction of its natural ecotopes...*

...T. sordida *uses a wide variety of different food sources ... The insect's feeding habits are in fact largely dictated by 'opportunity', with invasion occurring most intensely in ecotopes containing a greater number of food sources.*

The author concludes that *T. sordida* did not fill the ecological niche left open by the removal of *T. infestans*: *existing evidence suggests that transmission is not occurring in areas occupied by* T. sordida...

But while the author claims that *T. sordida* feed on *Didelphis* and on rats, which facilitates the circulation of *T. cruzi,* she agrees that it is not important in the epidemiology of Chagas' disease in the human population. The species is said to be declining, and its average rate of infection after 1984 was estimated at 1% of the captured specimens.

The mis-use of terms and concepts as *ecological adaptability, scope for reproduction, potential food, ecological niche,* makes explanations easy to find. *T. sordida* would be a vagile insect, with opportunistic feeding habits, capable of colonizing a variety of ecotopes, poor in food supply. But, in regions under cultivation, it would decline in numbers for lack of natural ecotopes. The author uses a circular argument when she states that *sordida* is fairly distributed owing to its extensive ecological adaptability. That "adaptability" allows it to frequent a variety of ecotopes; but where land is frequently worked, a decline was observed. The conclusion that this is the result of the reduction of its natural ecotope is meaningless. There might occur a reduction in ecological niches. Anyway, the conclusion is unsuported by existing data, and contradicts the initial statement of *sordida* being ubiquitous and adaptable, accepting a large variety of food sources.

## ECOLOGICAL TERMS AND CONCEPTS

Chagas' disease is interesting from several points of view: historically, it was discovered in a reverse sequence of what one would expect: first, what was latter recognized to be a vector; then a new parasite; then a correlation was made with a chronic condition of what was described as a new disease, disputed by some, and then proved true. A number of triatomine species are involved, in different degrees, in its epidemiology; the changing of habitats; human migration; urbanization of the disease through blood transfusions; house improvement; all contributes to confuse the picture, aggravated by the lack of knowledge of some very important aspects of the insects behaviour and ecology.

In the ever-growing literature on American trypanosomiasis, the inaccurate use of ecological terms and concepts is common. Ecological factors is an expression used in a loose way, as are many ecological concepts. I selected a few examples, to demonstrate the need for clarification, and their use in an appropriate manner.

*Natural* and *artificial*, as applied to habitats. These terms are employed, in general, in an anthropomorphic way. The term *artificial* should be avoided. Animals - specially small animals - live in microhabitats, limited by microclimatic factors. Deforestation and changes in the pattern of vegtation may be apparent and significant to us, but not always to other animals, even to small mammals, which may remain in place after a change has occurred in the plant cover. A change in the floristic composition, with corresponding modification of the vegetational aspect, may affect the fauna: not only through the change in food supply, but also through changes in light patterns, regulated by the shape of the canopy. Correlation of historic changes in plant coverage can hardly be associated directly with the changes in the pattern of distribution of certain animal species. Deforestation induces changes in human activities,

in population density, house building and economy, that may affect other animals. This situation is responsible for the introduction of intervening and confounding variables in the chain of causal explanation. Several species may profit from the conditions offered by *ruderal* habitats, as defined by Warming (1909) and Lund (1838), as by the removal or destruction of large predators, the increase in primary production, and by changes in light, humidity, and other ecological factors. *Ruderal* was applied originally to those plants that grow under disturbed conditions, in wastelands, waysides, or in old abandoned fields. Ruderal organisms are pioneers, in the earliest stages or *seres* of an ecological succession, colonizing areas disturbed by human activities. Golvan and Rioux (1963) demonstrated the influence of human activities upon the ecology of plague, in Iran, where certain rodent species live in arable land while others avoid it. Cultivation cycles are responsible for outbreaks of the disease.

*Domestication* and *domiciliation*: occupation or colonization of human constructions or buildings is not to be confused with the artificial process of selection and biological engineering of animal lineages suited to our needs. Domestication involves the loss of genes, and acquisition of new behaviour patterns, accompanied by changes in reproduction, feeding, and activity cycles, and new circadian and seasonal rythms. The use of another species' space, shelter, transport of food is called *commensalism*, which includes phoresy, inquilinism, and other types of specialized and particular relationships. House rats, cockroaches and other house dwelling animals are not domestic: outside their natural areas of distribution, they are only capable of living in association with man, and not in natural biotic communities. It should also be noted that domicile has no ecological meaning: a dwelling, a palm-thatched hut or a palace are domiciles, and offer very distinct conditions of habitat to other animals. *Synanthropic* is a better choice of term. *Sylvatic*, as opposed to synanthropic or ruderal, includes species that live in other natural habitats, and not only in forests (Lat. *silva*).

*Niche*, in ecology, means the function of an organism in a biotic community, not the place where it lives. Niche is often confused with microhabitat. Male and female mosquitoes fill different niches: males are phytophagous, where females are primarily haematophagous, occupying distinct trophic levels in an ecological chain.

*Habitats* and *microhabitats* have no rigid definition, and relate to landscape aspects of the environment. They are characterized by suitable conditions relating to and limited by combinations of factors like light, temperature, humidity, etc. Explanations based on the characteristics of habitats and habitat changes must be made with care, to avoid speculative causal correlations. Conclusions must be supported by correct association between independent and dependent variables. In 1978, a Brazilian hebdomadary magazine (*Manchete*, June 3), and *Time* magazine (May 22) reported on the effects of deforestation in the State of Espírito Santo upon a group of immigrants from Pomerania, who arrived last century in Brazil. It was claimed that the removal of the forest cover was responsible for the appearance of many cases of skin cancer, which was called by the Brazilian Minister of Health, followed by the media, ecological cancer.Two facts were overlooked: first, that the immigrants, as agricultural workers, have always worked under the tropical sun, in small clearings; second, they are a close-knit and endogamous society; and to link such a wide scope change as forest cover with localized events occurring in microhabitats leads usually to wrong causal correlations.

*Food preference*: very often conclusions of food preferences are reached without a careful analysis. Chance feeding, opportunism, and actual preference are confused due to lack of training in behavioural observation and ethological experimentation. It is commonly deduced from data collected unsystematically in the field, or from randomly captured specimens, and not from properly conducted and controlled tests.

*Vagility* means the ability to cross barriers. Vagility potential is related to the means of locomotion and of dissemination and dispersal.

*Dispersal centers*, or *centers of distribution* are concepts derived from old biogeographical theories of origin of faunas and floras, as those proposed by Willis (1970), and elaborated by Cain (1951). The dissemination of diasporae (polen, seeds or larvae) inside the limits of geographical (and ecological) distribution of a given species is not to be confused with the colonization of new habitats beyond those barries. Dispersion, in this later sense, has an evolutionary meaning, and involves preadaptation, and change in the gene pool of the species. We must distinguish, also, between true adaptation, that is a step in the process of speciation, and accommodation, which depends upon individual differential tolerance, in the face of limiting factors. Individual variation accounts for survival of the species, in a changing environment. As Allee et al. (1950) wrote many years ago *another aspect of preadaptation is found in the fitness of organisms adjusted to new habitats that*

*have many factors in common with the habitats originally occupied by the ancestral forms. In some cases, new habitats are invaded without evolutionary modification. Many animals and plants introduced successfully into a region new to them exhibit such preadaptation.*

In Aragão (1975), we find a datailed discussion of the role of preadaptation in the process of colonization of new habitats.

Concerning dissemination, a popular misconception is that insects are attracted by a source of light, of the visible or invisible spectrum for the human eye. They are certainly disturbed and disoriented, and insect collectors know that certain insects do not fly when moonlight is shining brightly.

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