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More on Speciation - A view

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ABSTRACT: Speciation is a continuum of divergent selection, in which certain levels are taken as separate species, keeping in view the Biological Species Concept. The divergent selection operates on variability in populations, resulting from mutations and from gene flow or genomic hitchhiking. An incipient species enters or initiates an ecological niche, which is, as per the modern concept, a hyper volume, including biologically related organisms.

Key words: Divergent selection; Ecological niche; Ecological speciation; Genomic hitchhiking; Gene flow.

INTRODUCTION

"Species and Speciation" have been discussed in an earlier communication (Verma *et al.,* 2013). In that review paper it has been said that speciation is a continuum of divergence and in this continuum taxonomists make out certain levels as species, keeping in view the Biological Species Concept (BSC). They take the levels, which differ considerably in their phenotypic features from the previous and the following levels, as distinct species, taking the considerable phenotypic divergence as indication of reproductive isolation. That thus making out of species involves some arbitrariness cannot be denied.

It is of interest to note that, as pointed out by Thompson (2009), commonly it is believed that genetic constitution of a species is constant, ignoring the potential genetic dynamism of populations, communities, and ecosystems, In view of this dynamism it has been rightly asked whether the modern humans (*Homo sapiens*) are still evolving (Verma, 2012). Speciation involves divergent selection. Selection works on genetic variability.

GENETIC VARIABILITY

How is genetic variability in a population produced? It is held that it results from accumulation of mutations, both beneficial and indifferent. But another source of genetic variability is now known, viz. gene flow (Feder *et al.,* 2012). This phenomenon has also been called genomic hitchhiking (GH).

In this event a part of a DNA sequence gets separated from its original position, and may get attached to another part of the sequence. This change affects the original gene interaction pattern. As a result a new genetic type is produced, which may get separated by some distance from the original population, and thus may be free to evolve adaptively independently, in which situation this result in speciation in a new direction.

The authors (Feder *et al., loc. cit.*) have cited a number of cases, wherein speciation, resulting from divergent selection, following GH or gene flow may be suspected. They have cited and discussed at some length the genomes of certain species and races of *Heliconius* butterflies, and have inferred that origin of some races/species has been through divergent selection following GH or gene flow.

Mair (2010) has discussed the reinforcement mechanism between two drifting apart conspecific populations, resulting in reproductive isolation between them. The author points out that two populations, which are in two ecologically somewhat different situations, may hybridize in the meeting zone, but such hybrids are generally inviable or sterile. This situation reinforces reproductive isolation between them. This situation has been illustrated by citing the case of two related species of *Drosophila*, *D. yakuba* and *D. santomea*, between which sometimes hybridization occurs, and the males, resulting from the hybridization, are sterile. The reproductive isolation strengthening mechanism is obvious. Verma *et al.* (2013) have also emphasized gradual strengthening of reproductive isolation during speciation.

AN ENVIRONMENTAL NICHE

An incipient species enters or contributes to an environmental niche. The modern concept of an environmental niche, as pointed out by Hutchinson (cited by Kitching, 2013) is that it is a hypervolume space, defined by many environmental dimensions, both biological and physiochemical, which determine presence (or absence) and well being of an organism. Thus a niche includes a small community, consisting of a species in question, along with its parasites/predators/food source, all interacting. Thus a niche is a multidimensional concept. It may still leave space for a 'new comer'.

As Kitching (*loc. cit.*) has mentioned, the niche for the lepidopteran *Paralucia spinifera* in Australia includes its food plants, attendant ants, and absence of 'congeners'.

ECOLOGICAL SPECIATION

Nocil (2012) has defined ecological speciation as the process by which reproductive isolation between populations evolves from ecologically based divergent selection.

Charles Darwin was well aware of the importance of the role of ecological factors in shaping the course of evolution (Thompson, 2009). Thompson (*loc. cit.*) says that some phenotypic features respond more readily to changing environment than others. Fundamental features, like bilateral symmetry in higher animals, are least affected by changing surroundings, whereas other features respond more obviously to changing environs.

In a review of the book by P. Nosil, "Ecological Speciation", Futuyma (2012) points out that the author has overemphasized the role of gene flow in speciation.

MacColl (2011) has suggested more of experimental approach to the effect of environmental factors on organisms, and the strength of selection, resulting from changes in such factors. Further he has recommended that the data, emerging from this approach, and such existing data should be subjected to appropriate statistical analysis, as this will provide a clear understanding of how environmental factors affect the course of evolution through natural selection.

SPECIATION THROUGH SEXUAL SELECTION

It has been suggested that sexual selection contributes to speciation. Kraaijeveld *et al.* (2011), as cited earlier also (Verma *et al.*, 2013), have tested this hypothesis, by extensively reviewing the published data for different groups, and have statistically and phylogenetically analyzed the data. They have inferred:

(1) that there is a small but significantly positive support for the hypothesis; and
(2) that the frequency of the correlation between sexual selection and speciation varies considerably among different taxa, e.g. :
    (a) Among the available data for birds in 38 studies, 24 showed positive correlation,
    (b) Among the available data for insects in 6 studies, in 4 studies the hypothesis was supported, and
    (c) Among 14 studies on mammals, none was found supportive.

SYMPATRIC SPECIATION

A general notion is that reproductive isolation between related populations develops in allopatry. But it may develop in sympatry too, if the two populations are in the same general area but in different niches. Speciation in sympatry has been discussed by Verma (2010).

CONCLUDING REMARKS

The continuum of speciation is maintained by divergent selection, supported by genetic dynamism of populations, communities and ecosystems. The genetic variability, needed for the selection, is provided by accumulation of mutations, and also by gene flow through genetic hitchhiking. An incipient species contributes to or initiates an ecological niche, which is a hyper-volume, including a small community of biologically related organisms. Ecological factors shape the direction of the divergent selection involved in speciation.

REFERENCES

Feder, J. L., Egan, S.P., and Nosil, P., 2012. The genomics of speciation – with gene-flow. *Trends in Genetics*, **28(7)**: 342 – 350.

Futuyma, D., 2012. The origin of species by means of ecological selection. (A review of the book, "Ecological Speciation" by P. Nosil). *Current Biology*, **23(5)**: R218.

Kitching, R.L., 2013. Niches and neutrality: community ecology for entomologists. *Australian Journal of Entomology*, **52**: 1 – 7.

Kraaijeveld, K., Kraaijeveld-Smit, F.J.I., and Maan, M.E., 2011. Sexual selection and speciation: the comparative evidence revisited. *Biological Reviews*, **86(2)**: 367 – 377**.**

MacColl, A.D.C., 2011. The ecological causes of evolution. *Trends in Ecology and Evolution*, **26(10)**: 514 – 522.

Mair, W., 2010. Reinforcing reinforcement. *PLoS Biol.*, **8(3)**: e1000340.

Nosil, P., 2012. *Ecological Speciation*. Oxford University Press, Oxford, U. K., p. 1 – 280.

Thompson, J.N., 2009. Which ecologically important traits are most likely to evolve rapidly. *Oikos*, **118**: 1281 – 1283.

Verma, K.K., 2010. Sympatric speciation. *Journal of Threatened Taxa*, **2(4):** 820 – 823.

Verma, K.K., 2012. Are modern humans (*Homo sapiens*) still evolving? *Human Biology Review*, **1(4):** 327 – 330.

Verma, K.K., Jolivet, P. and Saxena, R., 2013. Species and speciation. *Biological Forum*, **5(1):** 42 – 49.