THE BASIS FOR THE EXISTENCE OF SPECIES

Brian Tunstall

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Abstract

The question of why organisms tend to form distinct groups such as species is addressed and a mechanism provided.

Introduction

The existence of species is generally accepted. It is also generally accepted that species are lost and new species arise through evolution. The mechanism of natural selection provides an explanation as to how this arises. However, as described the mechanism of natural selection need not produce disjuncts in the distribution of biota identified as species.

With natural selection the biota change in relation to their environment. Disjuncts in the environment should produce disjuncts in the distribution of biota, and this is generally identified as being the basis for the existence of species. However, by the same rationale a continuum in environment should produce a continuous distribution in the variation of biota.

Environmental continua are common thus this mechanism should have resulted in a prominence of continua. However, continuous distributions in biological variation are uncommon compared to disjuncts such as species, thus the mechanism does not apply. Species do not arise simply because of differences in the environment.

The context for biological disjuncts is further examined and a mechanism for speciation identified.

Context

Species

Species represent the main form of biological disjunct whereby individuals are identified as being similar within groups but different between them. Some characteristics may overlap between groups but overall the differences between individuals within groups are considerably less than between. This is the basis for the Linnaean system long used to classify biota.

Advances in science post Linnaeus have provided a basis for the hierarchy incorporated in the Linnaean system by providing a family tree. With classification the family linkages are identified by assuming that similar individuals are more closely related than dissimilar individuals. While not failsafe, this has provided a very good approximation.

The taxonomies of organisms now seek to emulate evolutionary development. However, evolutionary classification is intrinsically divisive through different species deriving from common ancestors whereas the Linnaean system is intrinsically agglomerative. The approaches are not fully compatible.

The Linnaean system starts with the assumptions that species exist and can be clearly identified. However, no basis is given for the existence of species. Evolution identifies that the form of biota can change over time but again there is no fundamental basis for the grouping of biota into species. The approaches are pragmatic in accepting the existence of species without knowing why different species should exist.

Animal taxonomists often cite barriers to breeding as the basis for speciation. The most obvious is where groups become isolated as the development of new forms (speciation) is then inevitable. However, many breeding barriers are behavioural rather than physical. The barriers to breeding have a genetic basis but they are not physical imperatives. There is no intrinsic reason why behavioural barriers should arise and, even where they exist, it is not inevitable that they need be applied. Behavioural barriers in many species can be broken to produce fertile offspring.

Identifying separation of breeding does not provide an explanation for the occurrence of species as with behavioural separation it does not explain why the separation arises. It serves solely to identify that different species tend not to interbreed.

Plants clearly identify that speciation is not fundamentally due to the separation of breeding as different species can readily exist in close proximity, cross breed, and produce fertile progeny. While such cross breeding has the potential to create a continuum of plant forms this does not occur. Species remain distinct despite the capacity for crossbreeding and occurrence of viable and fertile crossbreeds.

The existence of species is generally accepted despite the lack of a causal mechanism, and the occurrence of numerous exceptions. Clines have been identified to account for gradual changes in species characteristics over environmental gradients. Subspecies have been introduced for no reason other than the difference between groups is less than would be expected for species. The identification of species is pragmatic, and so to is the identification of subspecies and every other such group.

Plant communities

The classification of plant communities has followed that of species with distinct forms being identified. However, unlike species, the occurrence of distinct forms of vegetation has essentially never been clearly demonstrated. Given the diversity of vegetation many vegetation forms are clearly different from others, as with rainforests from deserts, but within rainforests and deserts the vegetation tends to vary continuously. Distinct forms of vegetation can be defined but intergrades between them invariably occur. The defined states represent somewhat arbitrary points in a multifactorial space. This issue has typically been addressed by identifying more classes but this does not resolve the issue.

The debate on whether vegetation forms a continuum or distinct classes was prominent in the mid 19th century but was never resolved. Tunstall presents information identifying the existence of a continuum in vegetation with a continuum in environment, but first acknowledges the existence of disjuncts in vegetation with disjuncts in the environment. A case can be made for both.

Continua in vegetation are equivalent to clines with species, but the disjuncts in vegetation associated with the environment are not the same as with species. Environmental disjuncts represent spatial separation when different species can effectively occupy the same space. Spatial separation is not an essential requirement for speciation.

For spatially separate plant communities to be grouped into distinct forms of vegetation it is necessary to obtain numerous observations of all forms of vegetation to demonstrate the existence of distinct groups without intergrades between them. Where this has been rigorously attempted, which is rare because descriptions of vegetation have almost invariably been biased by the selection of typical forms, there have always been intergrades. The existence of both the discrete forms and the intergrades has always been attributed to differences in the physical environment.

There has effectively been nothing that clearly demonstrates that vegetation forms distinct groups or classes as arises with species. Vegetation is identified as varying with the environment, and the existence of disjuncts in forms of vegetation then depends on disjuncts in the environment. While some features in the environment can occur as disjuncts, as with geology and water, many others occur as continuous variables.

Vegetation exists as a complex of forms where the forms vary with continuous and disjunct factors. The relative effects of the continuous and disjunct factors, and hence their significance, have never been fully determined[1]. However, the prominence of continuous variables results in a tendency for the environment to generate continuous variation in vegetation within distinct categories such as swamp and geologies.

The comparison of brigalow and poplar box communities represents an exception in identifying that the disjunct in the environment associated with the two plant communities is caused by the associated plant species (Tunstall 2008). That is, plants species can form distinctly different communities within an environmentally uniform system. Plant communities can develop disjunct states similarly to species.

Individual plants and assemblages of plants can form both continua and disjunct states. Disjuncts in the distributions of individuals are common, and groups of like individuals are identified as species. Disjuncts in the distribution of forms of vegetation appear uncommon, but vegetation too can form discrete groups similar to species[2]. The issue is why this tendency to produce disjunct states? Why do organisms develop into discrete groups when starting with an environmentally uniform system rather than being uniform or forming a continuum?

Mechanism

The mechanism of speciation is evidenced by the segregation of brigalow and poplar box. Organisms alter the environment to their benefit. When one individual changes the environment to its benefit then other similar individuals can also benefit from that change. A mutualism develops through all of the like individuals similarly changing the environment, primarily to benefit themselves but inevitably to benefit all similar individuals. An optimum design, or species, arises through the modification of the environment by groups of interbreeding individuals.

Fuzzy boundaries are to be expected with this mechanism. So too is species drift as the environment changes as species develop. New species can occur through drift, or through

[1] It would be futile as the result depends on the situation examined. There is no set answer.

[2] Continua appear to be most common with vegetation, but the human penchant to allocate things to boxes and apply names has resulted in vegetation being treated in the same manner as species.

splitting arising where an individual develops a new means of changing (exploiting) the environment.

The nature and level of differences between groups is not set hence the level of difference differs between species. Moreover, the differences change with time.

A key aspect is that only one individual initially need have the new capability. That individual will be accompanied by 'hangers on', and eventually the population will develop unique characteristics that derive from the one lead individual.

While the direction is set by an individual its implementation depends on its adoption by a population. Only through adoption by a population can a new development be perpetuated.

Adoption of a new development by a population does not identify that it is correct, the best, or has any status other than providing benefit to some in a population. Rejection of a new development by a population does not identify that it is wrong, or that it could not benefit the population. New developments are commonly suppressed by a part of the population they could adversely affect even where a large potential exists for them to provide benefit to the bulk of the population.

This mechanism is universal and not restricted to speciation. It is the fundamental basis for the development of human communities.

Conclusion

The mechanism identified for the development of natural groups is simple and universal. It is central to evolution but extends beyond biological organisms to all matter. Those issues will be addressed elsewhere.

References

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