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Editorial

The Mexican Transition Zone The Historical Transition Process

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Introduction

My biogeographic ideas have been acquiring a more consolidated expression and meaning. They are not free, more than fifty years of doing biogeography. The central axis is a moving earth surface, on which not only the surface, but also the organisms that inhabit it, move. The earth is constant motion, but that motion is not random. Determinate influences, which establish what happens and what does not happen. At the same time, it happens with plants and animals; change, evolution is not a random process. For us everything revolves around a distribution problem, since this is what we are essentially interested in. The current distribution of beings I saw. But this current distribution is the result of the distributions of the pass and the movements of the Tierra. We have to consider that there are lands and oceans, but and this but it is very important, that living beings have their own characteristics that make them move and finally, something very important chance, chance plays a very important role in the distribution of organisms. We must accept movement as something primary and real. The essence of historical biogeography is precisely movement. Explain how current structures and distributions have come to be established.

As Juan José Morrone (2018) has recently pointed out, the Theory of the Transition Zone Mexicana has been incorporated into the proposals that are currently being discussed in the front row. In 1962 I published the first note on the subject. From the 60s several authors were already very interested in the subject, to the point that the Annual Review (1987), if it included an article. In a google academic search we found that to date there are 3165 references. This is nothing more than a desire to show that we are talking about thego vivo, something that is discussed. It gives a new conception of biogeography. And there are terrestrial spaces where two very different means are found: they are the Transition Zones. In these transition zones there is an over lapin both directions, with characteristics of very intense energy that causes the appearance of mountains and earth movements. The transition zones represent areas in which distinct cenocorons are found, i.e., forms with a historical origin at different times for evolutionary bio geograms. Son especially important, since in them many characteristics of the elements that make them up are manifested.

We have established the Mexican Transition Zone that corresponds precisely to the contact and "clash" between the Nearctic and Neotropical regions. In this Zone we have established a series of divisions depending on the biogeographic history, which we are going to examine. The accumulation of quotations or the pointing out of the importance of a method (both things have been done repeatedly) do not necessarily contribute to the reader being able to evaluate a proposal (as is the Halffter Theory of the Mexican Transition Zone itself). Unless a formal rebuttal can be raised. It was indispensable to formulate the Theory as such and formally refute it. The theory aims to explain how and within the limits of space and time, different lineages of animals especially insects, some of northern origin, others of neotropical origin, have expanded following certain routes, giving rise to one of the richest faunas in the world. Halffter (2017) considers that one of the reasons for the exceptional megadiversity of Mexico lies precisely in the overlap of lineages of different origins. The elaboration of the Theory has followed a process of presenting hypotheses and accumulation of evidence from different taxonomic groups (see Halffter and Morrone, 2017; Morrone, 2015). In this note we try to shape the whole. The purpose is to subject the Theory to a process of contrast-refutation using molecular information.

Although transition zones have been mentioned in historical biogeography since the first divisions into regions, none have received attention equivalent to the ZTM (see Ferro and Morrone, 2014; Morrone, 2015b). As Halffter (2017) points out, the coincidence of a favorable climatic configuration (temperate-cold north, tropical south) with the dominant N-S arrangement in the mountain ranges (the Transverse Volcanic System is the only major exception) has favored the southward dispersion of elements adapted to temperate and cold climates following the upper part of the mountains, as well as the northward penetration of tropical elements following the coastal plains. In the ZTM, elements of totally different phyletic and ecological origin are superimposed. Mountain fauna is not an impoverished tropical fauna. These are elements of northern temperate-cold origin that have expanded from North America following the mountain ranges. The reader must take into account the time limits between which the various biogeographic-evolutionary events occurred (or we assume occurred): Cretaceous to Present ends. Events prior to the Cenozoic have very little influence on the patterns of distributions we studied, for a reason: the organisms that then existed were others.

The ZTM According to Halffter

This chapter is a compilation of Halffter and Morrone (2017) and Halffter (2017). As with any phenomenon or event in historical biogeography, the biota must be placed in space and time. In relation to space, in any biogeographic phenomenon but especially in a Transition Zone, the limits of the scenario must be set. Time is continuous, but phenomena occur in certain periods. The overlap of distributions of different origins that characterizes the ZTM corresponds to a lapse of time, it has not always existed. By Distribution Pattern we mean the current distribution of a cenocron. Cenocron (term introduced by Reig, 1981) is a set of taxa that share biogeographic history and ecological requirements, that is, they have a similar origin, both in time and space. The distribution pattern is the base unit of Halffter's theory of ZTM (see Halffter, 2017).

The two great continental masses, pangaea to the north and Gondwana to the south, were in contact in the Late Cretaceous. North America was divided by a huge, massive, oblique marine transgression that occupied the Mississippi basin, from the NW of Canada to the Gulf of Mexico. This sea divided the lands of North America into a western portion that maintained contact with Asia through Beringia and whose southern end reached Mexico; and another portion comprising eastern North America and maintaining contacts with Proto-Europe. At what geological time can we consider that the elements and conditions of a Transition Zone existed between North and South America? If we take as a reference group the Coleoptera: Scarabaeoidea coprófagos (group that we have studied), the paleogeographic and faunal conditions begin at the end of the Cretaceous.

The Paleogeographic Scenario

At the end of the Cretaceous, two archipelagos maintained an irregular communication between North and South America. The first was in a position similar to that of the current Central American bridge. The second, the Proto-Antilles, occupies a position further east. Between this first transition zone (rather a bridge) and the current ZTM there is a very important difference: the mountains of the current Transition Zone. Mountains are an important and determining part of the current Transition Zone. Unlike today, when more than half of the northern affinity lineages are associated with mountains, the surviving lineages of the first northern elements are dominated by those in the lowlands. We can test this claim by comparing via molecular tests the geological age of the Paleoamerican Mountain and Paleoamerican Tropical patterns, both of the same phyletic origin, the first distributed in the mountains, in the second in the tropical lowlands of the ZTM. The first Transition Zone would have in common with the current one, the contrast of two very different faunas: that of the north, originated in the case of insects mostly in the tropics of the Old World and with a wide Holarctic distribution; and lh austral-very peculiar-of Gondwanian affinities. At the end of the Cretaceous there was an active, although not massive, communication between North America and the northern part of South America through the aforementioned archipelagos.

Between the Late Cretaceous and paleocene, northeastern South America is connected to the north by the Proto-Antilles. The neotropical elements that will follow the Distribution Pattern in the Altiplano, pass into the current Mexican territory at that time. Even elements of neotropical origin arrive and diversify in the current territory of the United States, taking advantage of the warmer conditions that remain until the Eocene-Miocene. In the Paleocene this connection is interrupted. It will be re-established in the Miocene (Montes et al., 2015). This is the biggest interruption of the direct connection. During this period, marine transgressions cover much of South America, from Patagonia to Bolivia and Peru, clearly separating the north-northwest of South America from the south-southeast of the continent (Donato et al., 2003). The Mesoamerican Mountain Cenocron, integrated into the Central American Nucleus expands to the south, but is especially north of the Nucleus during the Oligocene-Mioceo period. During the Oligocene, the development of the Transverse Volcanic System (SVT) begins, an important set of mountains and volcanoes of 1000 km in length, which extends from the Pacific Ocean to the Gulf of Mexico between 18° 30' and 25° 30' north latitude. The SVT will mark both the dispersal and speciation of the mountain lineages of northern affinities, being the most important obstacle to the northward expansion of the neotropical lineages. With the appearance of the SVT, followed by the elevation of the Altiplano, phenomena that develop during the Miocene, the Mexican Altiplano becomes a North American peninsula, isolated from the tropical lowlands by the Sierras Madres Occidental and Oriental and by the SVT itself. It is these conditions that mark the development of the elements that follow the Pattern of distribution in the Altiplano, of ancient neotropical origin, diversifying and restricted to the Mexican Altiplano. From the Pliocene, the ZTM reaches a geographical conformation similar to the current one, which favors the penetration to the south of the Holarctic fauna and to the north of the Neotropical. The orographic-climatic structure favors this exchange. The early Cenozoic periods, at least until the Eocene, are markedly more tropical than they are today. As we have pointed out, the Mexican Altiplano, whose elevation begins in Miocene, preserves a fauna of neotropical origin, but that evolves in isolation: the Patron of the Altiplano, fauna to which Are added Nearctic elements of later arrival. The mountain ranges (Sierras Madres and the growing SVT) are the barrier to the expansion of the South American fauna, but also the way for the southward expansion of the Holarctic mountain fauna, via horizontal dispersion. In all these mountain ranges horizontal expansion dominates, which determines a strong speciation by vicarianza.

Pliocene-Pleistocene

The typical Neotropical cenocron (really a set of cenocrons) whose distribution gives rise to the Typical Neotropical Pattern, extends to the ZTM after the reconstitution of the Central American bridge: it is a modern invasion of lineages from the south that extends through the lowlands, tropical of Central America and Mexico. The consolidation of the bridge is a gradual process. In the Middle Miocene (10-5 million years ago, AP) there is an archipelago that as G.G. Simpson pointed out allows the passage of some groups of "island jumper" animals. Based on data from Lomolino et al., (2010), between 220 and 160 million years there is a relative continuity between Pangaea and Gondwana. Between 140 and 75 million years this continuity is broken; the interruption will end in the Middle Miocene (3.6 million years AP) with the restoration of the connection between North and South America, with the Central American bridge, what was a precarious exchange becomes the Great American Biota Inter chance, one of the most important faunal exchanges in the history of life on Earth. It does not affect the fauna of the north and the neotropical ones equally. Thus, approximately half of the mammal genera of South America migrate to North America, on the contrary only 10% of the North American genera migrate to the south. To analyze the overlap and overlap of two biogeographical histories not only different, but with totally different origins, is to speak of a transition zone. A transition zone needs to occur in a physical, geographical area, with limits in time.

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