COLEOPTERA OF AEOLIAN ECOSYSTEMS ON THE ATLANTIC ISLANDS

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Animal communities can develop in more extensive habitats lacking green plants. In recent decades attention has been drawn to the "allobiosphere", comprising zones in which photosynthesis is nearly absent and the resident heterotrophic organisms depend on organic material arriving from elsewhere. Terrestrial ecosystems of this type are known as "aeolian", being supported by mainly windborne material. This "biological fallout" may include pollen, spores, seeds, plant and animal fragments, and organic particles derived from the sea, but often consists largely of dispersing arthropods.

Aeolian terrestrial ecosystems occur in alpine, polar and perhaps extreme desert regions. These are semi-permanent systems, showing only long-term "abiotic" succession caused by external factors such as climatic change.

But volcanic eruptions on land produce new and sterile habitats that change more rapidly because they are also subject to the effects of biologically induced succession: we include here the joint effects of microorganisms, plants and animals.

On the surface these habitats consist of lava flows and areas covered with various types of pyroclastic deposits. Early colonization of the barren surface habitats is mainly by species that disperse by air (e.g. some spiders and carabid beetles) and which are predators or scavengers feeding on biological fallout. If there are adjacent areas of older rocks the initial colonists are gradually joined by pedestrian species. As primary vegetational succession proceeds the aeolian communities are replaced by more complex ones supported mainly by local photoautotrophic production. Biological fallout of course continues, but its role is no longer easily established.

On Hawai'i, Howarth found that the cricket Caconemobius fori, the most abundant arthropod pioneer on very recent lava

and ash, was absent from vegetated lava nearby. The implication is that the species is "lavicolous", well adapted to life on these aeolian habitats. Comparable situations in the Canary Islands have been investigated by Ashmole & Ashmole, Campos and ourselves. This archipelago offers excellent opportunities for such investigation since there are lava flows at a variety of elevations and with a wide spread of ages.

We have studied barren lavas **(MAPA)** in La Palma, El Hierro, Tenerife and Lanzarote. Most of them are historic eruptions **(TIMANFAYA)** (that means less than 500 years old) like this one in Lanzarote (1730-36), **(LOMO NEGRO)** this in El Hierro (1800), **(TENEGUIA)** or this in La Palma (1971), the more recent eruption in the archipelago **(PLAYA NUEVA)** whose lavas reached the sea.

(TENO) Some are subhistoric, that is to say with between 500 and a few thousands of years, like this one in Tenerife. But some other are lacking vegetation not only because of the age **(TEIDE)**, but of the high altitude and very dry climate. This is the case of Pico del Teide, with hardly any plant from 3.000 m to the top (3.717).

The lavicolous communities are usually formed by a few species but a high number of individuals. In the lower and intermediate elevations, the true lavicoles (i.e. those species not found in older areas) were Thysanura, Collembola, an endemic Dermaptera, a cricket and only two beetles.

The communities inhabiting the lavas in El Hierro, La Palma and the lower part of Tenerife had only one beetle considered as a true lavicole: **(FOTO)** this is Gietella fortuna, a Melyrid described as a new genus and new subfamily two years ago. This species is restricted to a coastal strip with no more than 50 m wide.

(TIMANFAYA) The sites studied in Lanzarote are included in the Timanfaya National Park, **(MAPA)** an enormous amount of lavas covering more than 860 km². In this area was also collected Gietella fortunata **(MAPA GIETELLA)**, always in the coastal band like in the other three islands. And another Melyrid, **(IFNIDIUS)** Ifnidius petricola was present both at the coast and in the inland lavas **(MAPA IFNIDIUS)**; this species is only known from the new lavas of Lanzarote, and the other two species of the genus are in Ifni (Morocco) and on the coastal rocks of Salvage [illegible] on very recent lava

Islands.

An important feature is that both species, Gietella fortunata and Ifnidius petricola, always disappear as ecological succession proceeds and the lavas are covered by higher plants: **(MAPA LOMO NEGRO)** not a single specimen of these species was collected in testing traps set in the older lavas surrounding the historic ones, **(KIPUKA)** or in the so called kipukas, areas of old lava covered by vegetation. But they do have been collected in older coastal rocks **(ESQUEMA)** lacking vegetation because of the influence of the sea.

It seems therefore reasonable that lavicoles are eliminated from the more mature lava by competitive exclusion or by direct predation by later colonists. Then ¿why they do not become extint? Howarth argued that in Hawai'i the high frequency of eruptions ensured a continuous suitable habitat for lavicoles. But in the Canaries eruptions are less frequent, and probably the narrow coastal strip is a refuge not only for the beetles here concerned, but also for other srict lavicoles like the earwig Anataelia canariensis and the cricket Mogoplistes squamiger.

Lavicoles may tipically evolve as halophilic coastal species whose adaptations to high salinity preadapt them to life on barren lava further inland.

On the Azores **(MAPA)** the situation could be similar since the volcanic eruptions are roughly of the same frequency as in the Canaries. But the climate is much wetter, and succession on the lavas runs much faster. We have studied some ten lava flows there, but only one was poorly vegetated enough to hold a lavicolous community: **(CAPELINHOS)** this is the Capelinhos crater, on the island of Faial. Another melyrid was found there **(GIETELLA FAIALENSIS)**, Gietella faialensis, clearly a vicariant of the Canarian species. **(DOS GIETELLAS)** Here you can see the two species together.

(CRATER CAPELINHOS) This is the place where Gietella faialensis was collected. The isolation of the lavicoles in distant lava flows is more extreme on the Azores, since they are eliminated sooner because of the quickness of ecological succession; but for the moment we have not confirmed their

presence in the coastal strip as a refuge.

Coming back to the Canary Islands, we finally have to point out the very different model found on the lavas at high altitudes **(TEIDE)**. On the last few hundred meters of the Teide peak (3.717 m a.s.l.) there is a severe aeolian ecosystem, **(MUSGOS)** since primary production is restricted to the presence of some mosses and very scarce higher plants at the mouth of the fumaroles **(FUMAROLA)**.

The fauna collected there was relatively rich, mainly due to the abundant fallout coming with the winds. The resident arthropods living there (harvestmen, spiders, millipedes and one beetle: Hegeter lateralis) are not true lavicoles, since they all are species occurring in lower vegetated areas. Probably the lavicoles are fugitive species capable to colonize extremely poor habitats like the flows, but unable to survive in the high mountain conditions, while some preadapted alpine species do.

ABSTRACT

The lava flows just after volcanic eruptions are completely sterile, lacking any kind of life. A long time is necessary until the first macroscopic plants (mainly lichens and mosses) can colonize the barren rock, this period depending on the climate. Thus the primary production is unexistent or limited to scarce cyanophytes only capable to survive when humidity is high. This and other biotopes on earth lacking primary production like the sea floor, the sand dunes or the snow patches on high mountains have been called together the allobiosphere (EDWARDS, 1988); probably the deep cave environment could be added too.

The pioneers in the colonization of newly formed lavas are not the lower plants but some arthropods called lavicoles. Lack of primary production on very recent lavas force these species to feed on windborne debris and aerial plancton. These aeolian communities are usually formed by a few species but very abundant in individuals. While plant succession goes on and the autochthonous production increases, the lavicoles are gradually displaced by more competitive species.

There are some beetles among the lavicolous communities inhabiting the recent lavas on the Azores and the Canary Islands. Some of these species are lavicolous in a wide sense, whereas other are restricted to a narrow strip at the sea shore. The latter - obviously halophilous - can be also found on the older, hardly vegetated coastal lavas. This habitat is considered as a refuge for the lavicoles during periods of time without volcanic eruptions.

On the Azores, where the climate is mild and very rainy, plant succession runs very fast and lava flows are rapidly covered by dense vegetation. A single lavicole species of beetle, Gietella faialensis Menier & Constantin, was found in the only poorly vegetated eruption on the archipelago, the Capelinhos crater. This volcano (1957-58) is at the sea shore, and the presence of the beetle was suspected and finally discovered after the experience with the Canarian Gietella fortunata Constantin & Menier, the other known species of the genus.

On the Canary Islands dry areas are much more frequent and the lavas need many years to be densely colonized by lichens, and usually thousands of years to be completely covered by soil and higher plants. The barren lava occupies an extensive area of Lanzarote and is well represented on Tenerife, La Palma and El Hierro. In all these islands Gietella fortunata is found on the coastal lavas, while Ifnidius petricola Plata only occurs in Lanzarote, mainly occupying the inland lavas flows.

A different aeolian ecosystem is found at the high mountains in Tenerife, where the high altitude and drought impede the normal presence of plants. The resident beetles found there are doubtless feeding on the fallout, but they are not proper lavicoles since they also occur in lower, vegetated areas.

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