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## One island, two geckos and some powder. Why and how a colonization process can fail?

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**Abstract.** The Corsican Giraglia islet is inhabited by two gecko species. One of them *Euleptes europaea* is widespread on all the rocky outcrops, while *Tarentola mauritanica* is strictly restricted to the walls of a single construction. We hypothesized that the powdery prasinite rock was the key factor constraining its expansion. Preliminary field experiments and analyses corroborated this view.

**Riassunto.** L'isolotto corso di Giraglia è abitato da due specie di gechi. Una specie, *Euleptes europaea*, è diffusa in tutte le zone rocciose, mentre *Tarentola mauritanica* è presente solo sui muri di un'unica costruzione. Si ipotizza che la prasinite, roccia polverosa, sia il principale fattore che ne limiti l'espansione. Alcuni esperimenti preliminari in ambiente naturale sembrano corroborare questa ipotesi.

**Keywords.** Adhesion, Colonization failure, Gecko, Rocky substratum.

We report and discuss the preliminary results of the study of a failed colonization of the Corsican Giraglia islet by the Moorish gecko *Tarentola mauritanica*.

Giraglia islet is located at the northernmost point of Corsica (43° 01' 30" Nth; 9° 24' 24" E; area 10 ha, 65 m asl, distance to the coast 1.4 km), for further information (Delaugerre, 2013; Rivière et al., 2012). It is made of prasinite, a green and soft metamorphic rock. The islet hosts four species of reptiles: *Euleptes europaea*, *Tarentola mauritanica*, *Podarcis tiliguerta* and *Hierophis viridiflavus* (Lanza and Poggesi, 1986).

The Moorish gecko is lacking in most of the circum Corsican islets: while 85 of them are inhabited by a single reptile species, *T. mauritanica* is known from only three of them, all located at the Cape Corse Point. Probably this gecko colonized Corsica during the Antiquity or the Middle Age [like *Podarcis sicula* its colonization of Corsica is still ongoing (Delaugerre and Cheylan, 1992) M. Delaugerre pers. obs.], when the landbridge islets had already been severed from the main island by sea level rise.

Since 2000, repeated herpetological investigations, performed mostly by night, evidenced

a huge discrepancy in the distribution of the two geckos. While *E. europaea* lives on almost all the rocky outcrops and on the buildings of the island (Genoan tower, lighthouse and technical constructions...), *T. mauritanica* has been sighted only on the external walls of one small construction and never elsewhere on natural surroundings. The presence of this later species is reported on Giraglia since the 70's (Lanza and Brizzi, 1974) and the reason why it didn't expand and colonize the entire island is puzzling. If we compare with another -much larger- Mediterranean island, the Northern Tunisian Galita (752 ha, 391 m asl); here *T. mauritanica* arrived during the second half of the 20<sup>th</sup> century (Lanza and Bruzzone, 1959; Schneider, 1969; Lanza, 1973) and it is nowadays widespread on the entire island (Delaugerre et al., 2011). We realised that on Giraglia island the Moorish geckos were always found on walls made of cement or concrete and never on the natural rocky substratum of the island: prasinite (neither on the Genoan tower or the lighthouse both made of prasinite stone). We then hypothesized that substratum was the key factor constraining its expansion: unlike *Euleptes*, *Tarentola* was not able to forage on prasinite and was therefore restricted to man-made cement/concrete substrata. Several investigations and experiments were performed to test this hypothesis:

- ☒ Experimental release of *Tarentola* on prasinite horizontal and vertical surfaces
- ☒ Macro photography of both species on both substrata (to figure out the way they were using their toe pads and claws)
- ☒ Inquiry on the age of the building used by the Moorish gecko
- ☒ Examination of the size and structure of prasinite powder with Scanning Electron Microscope (SEM)
- ☒ Investigations for geckos in other prasinite spots in Corsica.

#### **Experimental release** (documented with photos and videos)

Two adults and one subadult were released on prasinite for observation.

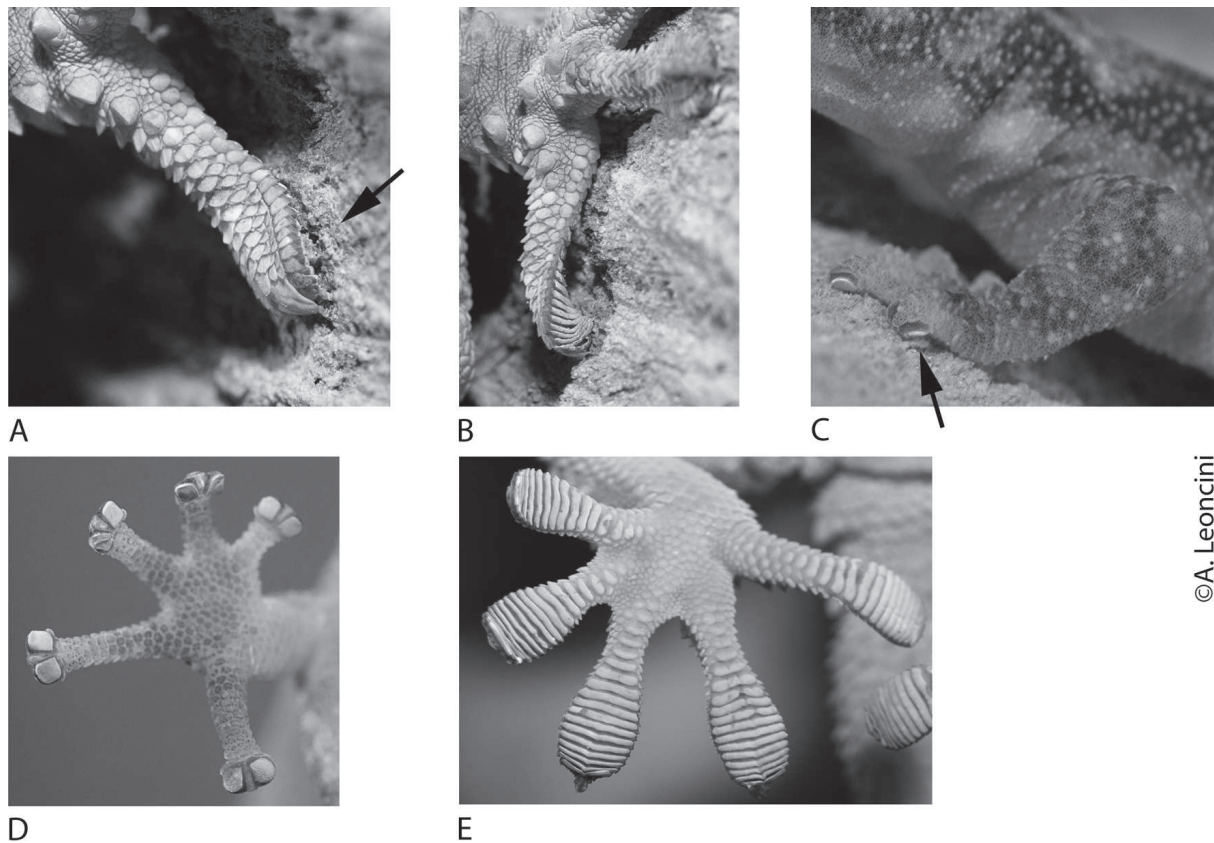
Horizontal surface: once released, the geckos started to flee, after a 20-30 cm run they were no longer able to grip the substratum and their hands and foot slipped.

Vertical surface (the more powdery rocks were avoided): once released the geckos seemed very uncomfortable, almost paralyzed. Their claws gripped the substratum and their toe pads were obviously not able to perform adhesion. When they tried to move, most animals slipped or fell down.

**Macro photography** (performed by night by A. L.) with experimental release of both species on both substrata (Fig. 1).

Cement/concrete: *E. europaea* used its 20 claws and kept its toe pads in contact position with the substratum; *T. mauritanica* used its 8 claws (functional claws only on the 3<sup>rd</sup> and 4<sup>th</sup> digits) and toe pads in contact position. Both species were able to move easily.

Prasinite: *E. europaea* used its claws and kept its toe pads in upward position, off contact with the substratum; *T. mauritanica* used its claws but was unable to disconnect its toe pads from the substratum. A thin layer of prasinite got stuck to the toe pads. Only *E. europaea* was able to adhere and to move easily on this surface.



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**Fig. 1.** A, B and C: experimental release on Giraglia island prasinite rocks. A) *T. mauritanica*, the toe pad is polluted by prasinite powder (black arrow) and is unable to grip the substrate; B) *T. mauritanica*, the toe pad is no longer able to perform its adhesive function; C) *E. europaea*, the functional claws cling to the substrate while the toe pads are kept in upward position (black arrow) of contact with the powdery prasinite; D) *E. europaea* has small leaf-like surfaces of toe pads and five functional claws; E) *T. mauritanica* has large toe pads with only two functional claws on 3rd and 4th digits.

### **Age of the man-made walls used by *T. mauritanica***

The construction where *T. mauritanica* has been observed shelters the motors that did produce energy for the lighthouse. This 70 m<sup>2</sup> structure was built in 1950 (M. Salvadori pers. com); before, there was no suitable substratum on Giraglia for this species (who might have been imported along with construction materials).

### **Electron Microscope analysis (in progress)**

The talc-like powder covering prasinite rocks displays a flake-structure. The smaller particles are sized 5-20  $\mu$ . We do not know yet how they interact with the spatula and the *T. mauritanica* adhesive apparatus (toe pad polluted and self cleaning system impeded?)

### **Investigations of other prasinite locations**

Three Corsican spots have been investigated by night for geckos.

Capandula (Cape Corse) on the coast in front of Giraglia: *E. europaea* and *Hemidactylus turcicus* observed; no *T. mauritanica* (present on the close surrounding rocks of serpentine and schist).

Santa Catalina (Sisco, Cape Corse Eastern coast): *E. europaea* and *H. turcicus*, no *T. mauritanica* (present on the nearby “manoir” and chappel).

Between Murato and Rutali (Nebbiu): no gecko.

As evidenced by preliminary behavioural observations and macro photos, the powdery prasinite is the key factor constraining the *T. mauritanica* expansion on Giraglia islet and explaining its colonization failure. The investigations performed in other Corsican prasinite spots strongly suggest that this particular rocky substratum is avoided by the Moorish gecko. The establishment of this gecko on the island is probably not older than 1950 when the concrete/cement building has been erected. Unlike *T. mauritanica*, *E. europaea* is able to move successfully on prasinite substratum, thanks to its 20 functional claws, to its ability to keep its toe pads in upward position and probably the small relative surface of its toe pads. Further studies will try to determine how and why the very fine prasinite powder interacts with the adhesive apparatus (fine particles pollution of setulae and impediment of self cleaning?), on the extensive literature on the topic see for instance Autumn and Peattie (2002), Irschick et al. (2006) and Russell et al. (2007).

Those preliminary results raise the following remarks and questions. For animals relying strongly on their adhesive apparatus such as geckos, substratum matters. It does for island colonization [Cole et al. (2005) evidenced a parallel case when an endemic gecko from Mascarene islands resisted an invader unable to colonize powdery rocks], as for any other territory.

The selective advantage of large pad-bearing toes geckos enabling them to colonize smooth and clean anthropogenic surfaces (and thus human habitats), can turn as a disadvantage in some peculiar conditions. This case study is not related to insularity. It could occur anywhere. But it is because it happened in microinsular context that the abnormality of a distribution was noticed and further questions addressed.

### **Acknowledgements**

Permits for handling protected species and for access to the natural protected area were issued by the Préfet de Haute-Corse (Arrêté Préfectoral 9/10/2012 n°2012283-001). All the Moorish geckos experimentally released on prasinite were later on replaced on their (favourite) cement walls. We thank Marc Salvadori (Phares et Balises, DTM) for the information and photos on the chronology of the constructions of the island. Thanks to Daniel Clément, the wise marine taxi man. Thanks to Kellar Autumn and Antony Russel for their interest and helpful comments.

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