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First record of partially melanistic individual of *Cerastes vipera* (Squamata: Viperidae)

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Resumen: La presente nota da a conocer el primer caso documentado de un ejemplar parcialmente melanistico en el género *Cerastes*, concretamente en la especie *C. vipera*. La descripción de la anomalía cromática del ejemplar se acompaña de una breve revisión de la variabilidad de patrones de coloración en esta especie y la distribución de las mismas lo que plantea interesantes interrogantes sobre su potencial adaptativo en diferentes contextos ecológicos y climáticos.

The coloration of ectothermic vertebrates plays a multifunctional role in many ecological and biological aspects such as immune response, parasite resistance, sexual selection, or intraspecies communication, as well as in thermoregulation processes (Clusella-Trullas *et al.*, 2007; Stuart-Fox & Moussalli, 2009; Allen *et al.*, 2013). Consequently, some of the factors that can affect the color pattern of many taxa are temperature, ontogenetic state, environmental season, state of excitation, and lighting (Tanaka, 2009; Wellenreuther *et al.*, 2014). Theory predicts that variable coloration enhances the rate of geographic range expansion and, in particular, melanistic expresion can have significant effects on the life history traits of many taxa (Protas & Patel, 2008; Lepetz *et al.*, 2009; Olsson *et al.*, 2013). The high frequency of melanism in many reptile populations has led to postulate the hypothesis of thermal melanism, for which, in cold environments, dark phenotypes have an advantage over clear phenotypes since they acquire heat faster and reach the temperatures necessary to perform their functions earlier vital (Clusella-Trullas *et al.*, 2007; Martínez-Freiría *et al.*, 2020).This thermic role which can be helpful to reach optimal thermal levels required for metabolism, in addition to an increase in the rate of growth and fecundity in females (Gibson & Falls, 1979; Hedges *et al.*, 1989). The drivers of melanistic polymorphism in general terms and the current hypotheses raised are still subject to debate due to the paucity of available histological and genetic studies (Forsman *et al.*, 2008; Zuffi, 2008; Domeneghetti *et al.*, 2016).

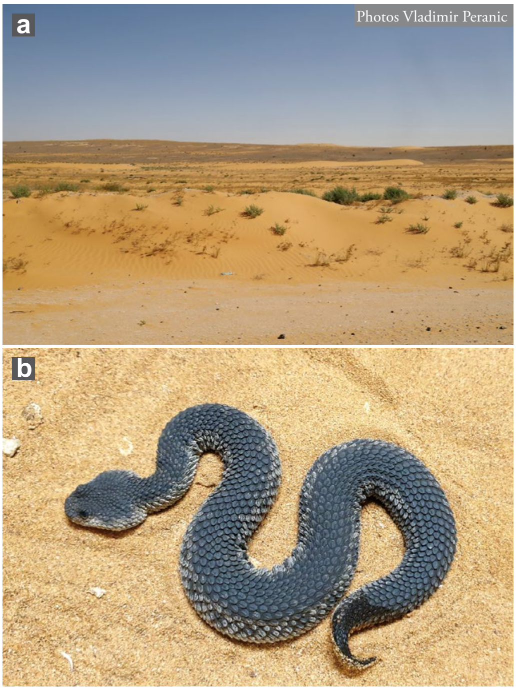

Figure 1: a) Habitat where *C. vipera* was found around southeast Tarfaya. b) Partially melanistic individual of *C. vipera* from Tarfaya population.
Figura 1: a) Hábitat donde se encontró *C. vipera* en el sureste de Tarfaya. b) Individuo de *C. vipera* parcialmente melánico de la población de Tarfaya.

Melanism is defined as a darker coloration due to increased expression of the pigment melanin, causing a darker coloration than that of the rest of the specimens of its species (Bagnara & Hadley, 1973; Bechtel, 1978; Bree Rosenblum *et al.*, 2004). This can lead depending on the phenotypic expression, different melanistic morphs (Zuffi, 2008; Domeneghetti *et al.*, 2016): 1) melanistic, i.e. individuals that display an entirely black colour phenotype; 2) melanotic, where melanism is nearly entirely expressed, with a few non-black body parts, which break the total melanistic expresión; and 3) partially melanistic, where the regular colour pattern has an increased black pigmentation. Considering snakes, different melanism expression was already documented in a couple of families such as Colubridae, Elapidae and Viperidae (Silva *et al.*, 1999; Costa-Campos *et al.*, 2015; Goiran *et al.*, 2017). Within the Viperidae family, melanism or melanotic specimens have been recorded in several genus: *Vipera*, *Macrovipera*, *Bothrops*, *Crotalus*, *Gloydius* (Da Silva *et al.*, 1999; Martínez-Freiría *et al.*, 2012; Shin & Borzee, 2020; Afroosheh & Kazemi, 2011; Hamdan *et al.*, 2021).

Figure 2: Specimen with dark colour and sand colour in the head.
Figura 2: Ejemplar de color oscuro y color arena en la cabeza.

Cerastes vipera is a small viper characterised by many xeromorphic physiological and morphological adaptations (Schleich *et al.*, 1996; Abukashawa *et al.*, 2018), distributed throughout North Africa and the Negev dunes in Middle East (Baha El Din, 2006; Wilms *et al.*, 2013). It is a species with very variable colours patterns distributed in well defined areas of the species distribution range (Martínez del Mármol *et al.*, 2019; Bouazza *et al.*, 2020): the coastal population between Tantan and Laayune shows a high number of specimens with general dark colouration (a rate of aprox. 70% based on 13 specimens) with grey background and almost black marks, whereas specimens out of these areas show a much clearer general colouration, with sandy background and brownish marks. Sexes are highly dimorphic, females usually have the tail black while males have a sandy or yellow tail (Marx, 1958).

The present study reports the first known case of partially melanistic individual in the genus *Cerastes*.The day May 17th, 2018, at approximately 19:30, the second author of this note found an atypical juvenile individual of *C. vipera* (SVL = 372 mm; TL [total length] = 380 mm; Figure 1b) observed during sunset at 20 km southeast of Tarfaya, in the region of Laayune-Saguia el-Hamra (UTM 30T X435689 / Y4463044.6). The humidity of the air was approximately 65% and the temperature was 24º C. Located in the Saharan Atlantic Coastal Desert ecoregion (Naia & Brito, 2021), the habitat was composed of succulents and halophytic plants such as *Lycium intricatum*, *Heliotropium undulatum*, *Atriplex*, *Zygophyllum*, with sandy loose soil (Figure 1a). This area is characterized by arid and strongly seasonal climatic conditions, with a maximum temperature of 26-37º C and a minimum of 12-16º C. The specimen was found active moving through the sandy substratum, leaving the typical sidewinder tracks of the genus.

The special climate in the Atlantic Coast of Morocco between Agadir to the Dakhla Peninsula has been already subject of previous studies. Jimenez-Robles *et al.* (2017) indicate that the frequent cloudy skies and horizontal precipitation (condensation drip) coming from the sea turn the Sahara climate colder, wetter and reduces the temperature range allowing the survivance of species with tropical distribution as *Dasypeltis sahelensis*, *Boaedon fuliginosus* or *Bitis arietans*. *Malpolon monspessulanus saharatlanticus* Geniez, Cluchier & de Haan, 2006, was described for the populations in these areas, in part by males where the "black saddle" is not only present in a small part of the body, but in most part of the body. A similar case is *Naja haje legionis*, the subspecies of the Egyptian Cobra described by Valverde (1989) where most of the adult specimens are completely black and where most of their records were made in the the Atlantic Coast of Southern Morocco. In contrary, many Saharan species (e.g. *Trapelus boehmei*, *Uromastyx nigriventris*, *U. dispar*, *Stenodactylus petrii*, *Scincus albifasciatus*, *Varanus griseus*, *Cerastes cerastes*) or Sahelian species (e.g. *Telescopus tripolitanus*, *Echis pyramidum*) are rarely recorded in these coastal areas (Martínez del Mármol *et al.*, 2019).

In this context, the case here described provides additional information on the presence and distribution of this type of pigmentation in *Cerastes* genus, and particularly in *C. vipera*. Whereas most of the cases of melanistic populations in reptiles are restricted to mountainous areas and cool climates (Monney *et al.*, 1995; Broennimann *et al.*, 2014; Martínez-Freiría *et al.*, 2020), these coastal populations with their special climate have also provoked the phenotypic dark adaptation of local species to get the correct temperature faster for their biological functions (e.g. thermoregulation). It's particularly interesting the encounter of specimens of dark colour in most part of the body except in the top of the head. This species expends lot of time buried in the sand with only the eyes and part of the head exposed, in ambush mode waiting for preys. Probably both preys and predators detect more easily the vipers with black head (Jackson *et al.*, 1976; Andrén & Nilson, 1981), so dark specimens buried in sand with only eyes and a part of head with sandy colour expose in ambush position are the perfect evolution model to get the correct temperature fast but later pass unnoticed in ambush mode (Figure 2; for more details see photos in Martínez del Mármol *et al.*, 2019). Therefore, we emphasize the need to detailed studies on environmental and ecological factors related to the existence of melanic specimens in *C. vipera* and its low frequency in the natural environment.

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Report of a negative interspecific interaction between *Cordylosaurus subtessellatus* and *Pachydactylus montanus* in southern Namibia

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Resumen: Durante una expedición diurna en KumKum, un área protegida de gestión privada localizada en el sur de Namibia y perteneciente al bioma del Nama Karoo, el 19 de agosto de 2019 fue observado un evento de interacción interespecífica negativa entre un ejemplar de *Cordylosaurus subtessellatus* y un ejemplar de *Pachydactylus montanus*.