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SKIN POCKETS AND THE LOCATION OF ECTOPARASITIC MITES ON LIZARDS OF BAJA CALIFORNIA

JOSÉ P. VEIGA[1], ALFREDO SALVADOR[1], CARMEN BLAZQUEZ[2] AND PATRICIA GALINA[2]

[1]*Departamento de Ecología Evolutiva, Museo Nacional de Ciencias Naturales, José Gutiérrez Abascal 2, 28006 Madrid, Spain*

[2]*Centro de Investigaciones Biológicas, CONACYT, km 0,5 camino Telefónica, CP 23000, La Paz, Baja California Sur, Mexico*

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The presence of skin invaginations in some lizards and their possible relationship with ectoparasites has been the subject of recent research interest. These invaginations, or pockets, often contain mites or ticks (Acarina), and it has been suggested that the concentration of ectoparasites in these pockets reduces their harmful effects (Arnold, 1986). This hypothesis has been challenged by some authors (Bauer, Russell & Dollahon, 1990), but the scarcity of empirical evidence in favour of each hypothesis leaves the controversy open. Experimental blocking of *Psammodromus algirus* pockets in the field induced a redistribution of ticks on their lizard host, with most ticks fixed to ears and axillae, reducing the lizard's mobility and survival. These results strongly suggest a functional role for skin pockets (Salvador, Veiga & Civantos, 1999). However, the kinds of harmful effect induced by ticks are probably different from those induced by other ectoparasites, so it cannot be concluded that the functional value suggested for *P. algirus* pockets may also apply in other ectoparasite-lizard interactions.

The presence of chiggers (Trombiculidae) on lizards has been examined in a few field studies (Allred & Beck, 1962; Arnold, 1986; Goldberg & Bursey 1991*a*, 1991*b*, 1994; Smith 1996). There is, however, scant information on ectoparasite distribution on lizards' bodies and on the factors that affect it. This information, though, may be a first step towards understanding the functional role of skin pockets. In this paper, we focus on the distribution of chiggers in three species of iguanian lizards. We investigate whether chiggers attach preferentially in pockets or are also found in other parts of the body and whether lizard size affects chigger distribution. As the capacity of pockets for sheltering mites is limited, we predict that their efficiency may vary with lizard´s body size. We also examine variation among species which differ in body size and pocket size. To eliminate macrohabitat and seasonal effects, the three species have been examined at the same site and during the same time of the year (end of the wet season).

Correspondence: J. P. Veiga, Departamento de Ecología Evolutiva, Museo Nacional de Ciencias Naturales, José Gutiérrez Abascal 2, 28006 Madrid, Spain. *E-mail*: jpveiga@mncn.csic.es

This study was conducted at Cañón de San Dionisio, Sierra de La Laguna, Baja California Sur, Mexico. Vegetation at 300-800 m altitude is arid tropical, and includes 32 species of tree and 60 species of shrub. Dominant plants are palo blanco (*Lysiloma candida*), mauto (*Lysiloma divaricata*), palo zorrillo *(Cassia emarginata*), cajalosuchil (*Plumeria acutifolia*), copal (*Bursera hindsiana*), palo de arco (*Tecoma stans*) and several species of morning glory (*Ipomoea* sp.) (León de la luz, Domínguez-Cadena, & Coria-Benet, 1988). Mean annual precipitation is 765 mm, mostly occuring during July-October (Coria-Benet, 1988). Between 5 and 14 October 1998, we noosed lizards from 0900 to 1300 hrs at both sides of the trail (elevation 400 m) between Las Veredas and San Dionisio ranches. Our sample includes immature and adult males and females of three species: *Sceloporus hunsakeri*, *Sceloporus licki* and *Petrosaurus thalassinus*. We measured the snout-vent length (SVL) of each lizard to the nearest mm using a ruler. We also noted the positions of chiggers on every lizard. Lizards were released at the capture site after examination.

To analyse whether chigger distribution on lizards' bodies occured randomly or whether ectoparasites prefer to attach inside or outside pockets, we performed a logistic regression using a maximum likelihood model and including interactions between independent variables.

We captured 16 *S. hunsakeri*, 17 *S. licki* and 31 *P. thalassinus* whose SVLs were, respectively, 46-85 mm (mean=70.5 mm, SE=3.0), 46-85 mm (mean=70.6 mm, SE=2.6) and 67-170 mm (mean=107.6 mm, SE=6.2). A comparison of the mean SVL's of - on the one hand - lizards with mites in pockets only, and - on the other - those with them in pockets and other body locations, showed that, in *S. hunsakeri* and *S. licki*, individuals with mites only in pockets were larger than individuals with mites also in other body locations, although the differences were only significant in the latter species (Table 1). The oposite tendency was recorded for *P. thalassinus*, but the differences were not significant. However, a logistic-regression showed that chigger distribution within and outside pockets was not random, and depended on lizard species (-2logLR=7.53, P= 0.02), snout-vent length (-2logLR=4.38, P=0.03), and their interaction (-2logLR=7.27, P=0.02). In both species of *Sceloporus*, chiggers were mostly attached to pockets in lizards with larger SVL, whereas chiggers were attached not only to pockets but also to other sites in lizards with smaller SVL. In contrast, chiggers were mainly attached to pockets in smaller SVL individuals of *P. thalassinus*, whereas chiggers were more evenly distributed between pockets and other body parts in larger individuals (Table 1).

TABLE 1. Snout-vent lengths (mean ± SE) of lizards with mites in pockets only and those with them in pockets and other body locations.

	Pockets only	*n*	Pockets and others	*n*	*t*-test	*P*
Sceloporus hunsakeri	71.4±3.2	13	66.3±9.3	3	0.65	0.53
Sceloporus licki	75.5±1.8	10	63.6±4.7	7	2.68	0.017
Petrosaurus thalassinus	104.7±7.7	22	114.6±10.7	9	0.72	0.48

It is possible that the pockets of small individuals of the two *Sceloporus* species studied here are not able to shelter many mites, so that these were found attached also at other body sites. On the contrary, adult *Sceloporus* seems to be able to provide space in their well-developed pockets for most mites. Explanations for chigger position based on body size differences in *Sceloporus* species fail to account for observations on *P. thalassinus*. On one hand, differences between *P. thalassinus* and *Sceloporus* could be explained by the smaller body size and the larger, well-developed pockets observed in *Sceloporus*. However, *S. licki* is semi-arboreal and is also found in rocks, and *S. hunsakeri* is associated with rocky habitats, whereas *Petrosaurus* is found on larger rocks (Alvarez-Cárdenas, Galina-Tessaro, González-Romero & Ortega-Rubio, 1988). Hence, differences between species in chigger distribution could reflect microhabitat effects, as mites may be associated with some microhabitat types (Allred & Beck, 1962).

Integumentary pockets may have arisen *de novo* in some lizard species, but in others their position suggests that they may be remnants of structures with a different function. In the lacertid lizard *Psammodromus algirus*, there is experimental evidence that pockets may redistribute ticks and prevent attachment in functionally important areas (Salvador, Veiga & Civantos, 1999). Although the conclusions of this particular study cannot be directly generalized to other species, pockets are located near legs and ears in most species, suggesting that a possible function of these invaginations is to prevent attachment of ectoparasites at sites where they could affect locomotion or hearing.

In conclusion, our results show that mites tend to concentrate in pockets rather than in other body parts, though there is considerable variation with lizard size and species. Although we have not counted the total numbers of mites on lizards, it seems that the presence of pockets may help to reduce the presence of mites in parts of the body where they could have a harmful effect. These results are in accordance with the hypothesis that proposes a functional value for the skin pockets. Additional work is, however, needed to reveal with more detail the role of pockets in the relationship between mites and lizards in these iguanian species.

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