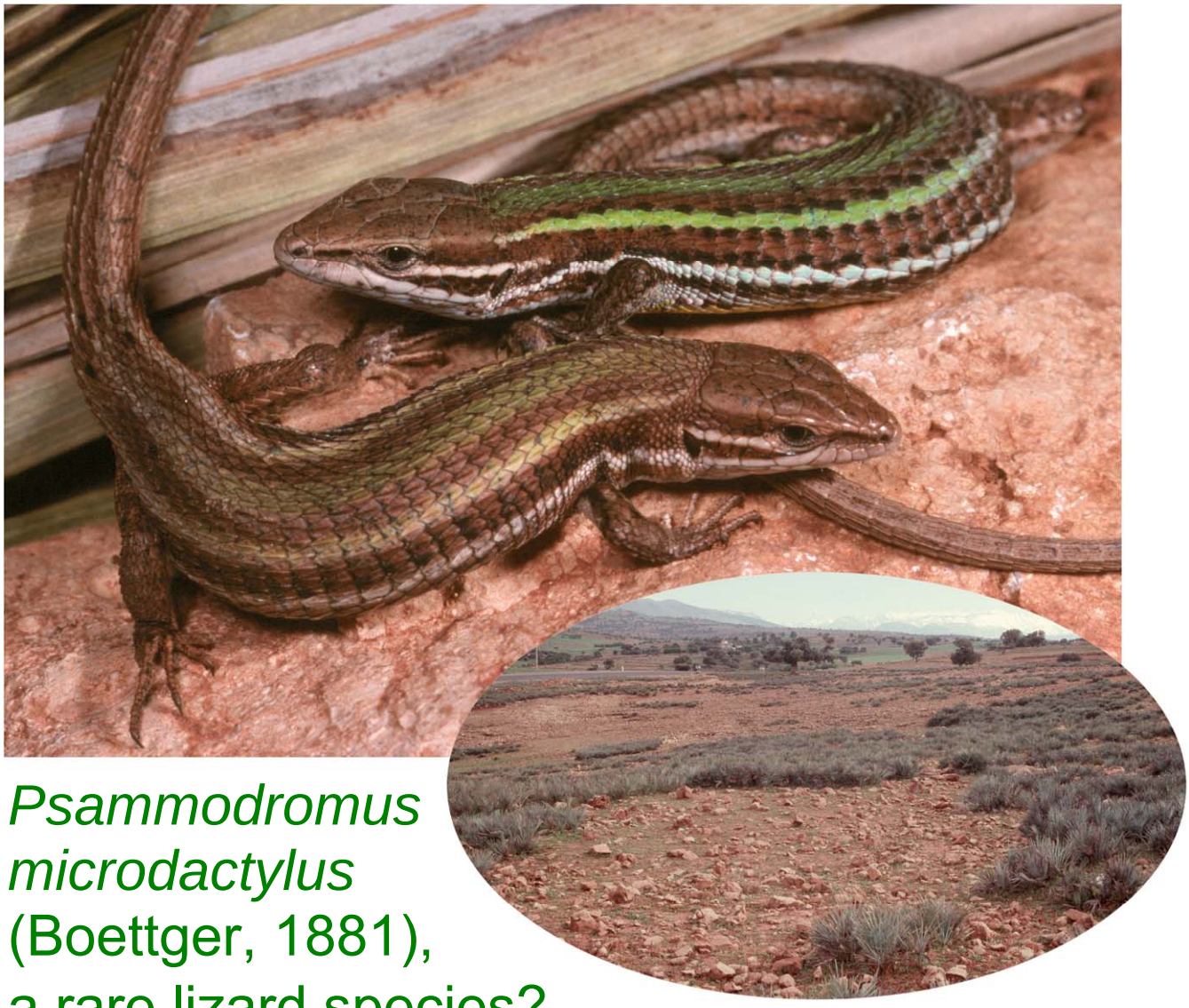

Psammodromus microdactylus (Boettger, 1881), a rare lizard species?

Fig. 1. Male (above) and egg-carrying female *Psammodromus microdactylus* in early April 2004.
Fig. 2. The new locality of *Psammodromus microdactylus* at Azilal.

Photos: H.A.J. in den Bosch

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INTRODUCTION

Four species are recognised in the genus *Psammodromus*: *P. algirus* (found in southern France, Iberia, and the Maghreb countries), *P. blanci* (Tunisia to western Morocco), *P. hispanicus* (southern France and Iberia), and *P. microdactylus* (endemic to Morocco) with the latter being the least known member. Ever since publishing on the first three (BISCHOFF & IN DEN BOSCH, 1991; IN DEN BOSCH, 1986b), it has been my aspiration to compare the data to similar facts about *Psammodromus microdactylus*. However, the species remained elusive: for over two decades, promises by various travellers to the region never materialised into animals. Most recently it has been searched for in vain by e.g. SCHLÜTER (2003). Evidently this should not have come as a surprise since for many years the only recent sighting was recorded by GENIEZ et al. (1993), although in this century three more records came to light (see below). In March-April 2004, I visited Morocco with two herp friends in the hope of finding this apparently scarce form.

This paper will discuss the known localities, habitat, field and first terrarium observa-

tions, the original description of *P. microdactylus*, and literature pertaining to it. Attention will also be paid to the confusion surrounding this species and *P. blanci*.

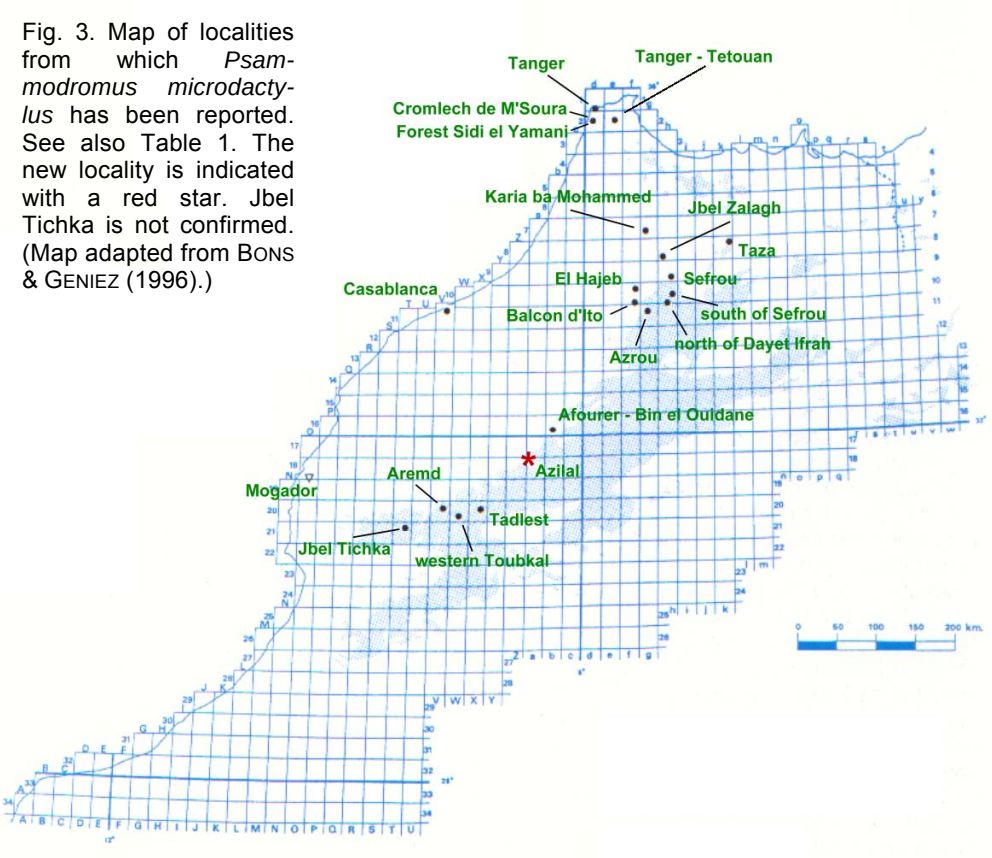


Fig. 3. Map of localities from which *Psammodromus microdactylus* has been reported. See also Table 1. The new locality is indicated with a red star. Jbel Tichka is not confirmed. (Map adapted from BONS & GENIEZ (1996).)

LOCALITIES OF *PSAMMODROMUS MICRODACTYLUS* FROM LITERATURE

The logical initial procedure was to visit the localities known from literature (see Fig. 3 and Table 1). Some places were omitted from the itinerary from the start, like Tanger or the district between Tanger and Tetouan (being the terra typica), since without exact geographical clues, and because of the gigantic growth of cities since the original description of the species (BOETTGER, 1881), finding the lizards there seemed less than likely. Similarly Casablanca and Mogador were skipped. Other localities that were not visited are: Afourer - Bin el Ouidane (lack of geographical detail), Balcon d'Ito (pouring rain), Cromlech de M'Soura and Forest of Sidi el Yamani (unknown to us at the time), 5 km N of Dayet Ifrah (lizard not captured and determination needed confirmation according to the authors). Various other halts were made where the habitat seemed suitable, but ultimately we only once met with success.
Jbel Tichka was claimed by GENIEZ et al. (1993) to be after WERNER (1931b) but no mention was found in Werner's paper. In WERNER (1931a: 254) "Tizi n'Tichka (2400 m)" is marked on the map as the pass which was crossed before the little fort Tadlest of the Foreign Legion was reached. According to WERNER (1931a), Tadlest is a *P. microdactylus* locality, while the pass is not. DESTRE et al. (1989: 21) added to this that the "Tizi-n-Tichka should not be confused with the Jbel Tichka, which is also found in the High Atlas, but is 130 km to the west" (translated).

FIELD DATA

The weather was cold and wet at many of the visited inland localities and day-time temperatures were often just a few degrees above freezing. We experienced frost with some regularity at night, as our sleeping bags would begin to make cracking noises caused by the formation of a thin layer of ice on them. As most sites were not precisely indicated, we searched the most likely surroundings in the locale, not avoiding the less pleasant, but often favoured lacertid places, like (municipal) rubbish heaps. In Karia ba Mohamed the rubbish heaps appeared to be our only option as the area either was built up or had undergone intensive large-scale agricultural use. Naturally we stopped between the known localities, concentrating on zones with tufts of *Chamaerops humilis* (Dwarf Fan Palm). An association of *P. microdactylus* with stands of this small palm species is often reported. The palm habitually seemed to remain as one of the few hardy plants after sheep, goats, or poor agricultural practice wreaked havoc on the vegetation. Even though temperatures were often hardly persuasive for lacertid activity, by turning

Locality	Date	Temp. °C	GPS, altitude (m)	Habitat description / remarks
Between Tanger and Tetouan [1], terra typica, BOETTGER (1881: 571): "Hab. Spec. 10 prope urbes Casablanca, Tetuan, Tanger (comm. ill. Hans Simon)"				WERNER's (1929: 23) "Tanger-Tetuan, Casablanca, Mogador (Boettger)" likely reiterated the original localities. "Near Tetuan in Mediterranean area" (WERNER, 1931b: 289) probably also repeated an original locality.
				Tanger and Tetuan were not visited; Casablanca was visited but not checked herpetologically.
Between Afourer and Bin el Ouidane (High Atlas) [10]: according to GENIEZ et al. (1993) after BONS (1967) [latter not seen]				GENIEZ et al. (1991) already mentioned the "surroundings of Bin-el-Ouidane in the High Atlas".
Aremd [13] (WERNER, 1931b: 289): "near Arround" Arround (WERNER ,1931a: 255)	24-26vi1930		1900 m	"in the High Atlas." "mountain slopes covered with large boulders … Again *Psammodromus microdactylus* was seen but, as in Tadlest, the single specimen was not caught."
	6iv2004	Sunny, strong wind, <15°C	1960 m N 31°07.962 W 07°55.419	Steep, windswept, barren rocky mountain slopes with few small shrubs.
West of Azilal, along road R304, 9.2 km E. from the turning to Ouzoud (Ait Autab), 58 km E. Demnate: new locality	4, 5iv2004, 16-17h / 8h30-11h	Sunny, approx. 25°C / >9°C-19°C	1300 m N 031°54:912 W 006°39:833	Overgrazed, denuded calcareous pasture, with compacted red clay, *C. humilis* as dominant plant species, and several small agricultural fields.
Azrou [9] (WERNER (1929: 14), and WERNER (1931b: 289)	13v1928, 30, 31v1930		1200 m	"near Azrou up to 1500 m … on a vast plateau in a small field of grain"
	2,3iv2004	Cloudy, intermittently sunny	1650 m N 33°22.42 W 05°15.596	Areas with *C. humilis*.
Balcon d'Ito [8]: GENIEZ et al. (1993). According to CROCHET et al. (2004) also called Lalla Ito	3x1992	Sunny		"Stony calcareous slopes overgrazed by cattle" and "sunning between 8 and 9 GMT"
Casablanca (BOETTGER,1881: 571)				Listed in the original description by BOETTGER (1881), but omitted in BOETTGER (1883) without explanation.
				Not checked.
Cromlech de M'Soura	early April 1997		30-50 m N 035°395 W 005°982	MATEO et al. (2003), further expounded in CROCHET et al. (2004): "area with wheat cultivation, patches of *Chamaerops humilis* and scattered *Quercus ilex*".
5 km N of Dayet Ifrah				GENIEZ et al. (1991) "in a field with *Asteriscus* … the animal could not be captured, the observation needs to be confirmed". Repeated in GENIEZ et al. (1993) "determination was considered as doubtful", and not indicated on their map.
Along road S310, 3 km north of El Hajeb [7]: GENIEZ et al. (1993)	3x1992			"Steep earthy slope with dense cover of *Chamaerops humilis*."
Road is now called R714	2iv2004	Rain, approx. 13°C	800 m No GPS	Exact spot investigated, numerous stones turned over without luck. Residents of nearby house cite 'small green lizards' on the hill.
Karia ba Mohamed [3], according to GENIEZ et al. (1993) after BONS (1967) [latter not seen]	ca. 1964			
	28iii2004	Rainy	100 m no GPS: lack of suitable habitat	Large-scale agricultural area, the rest of the area was very built-up, we were at a loss so we tried – without luck – the municipal dump as a zone which was in a sense less disturbed.

Mogador (BOULENGER, 1889: 304; BOULENGER, 1891: 128) = Es-saouira. Repeated in BOULENGER (1921: 175) Mogador (WERNER, 1929: 23)				BOULENGER (1889): "two from Mogador, collected by Lieut. Quedenfeldt": BOULENGER (1891): "obtained … by Lieut. Quedenfeldt at Mogador." It is surmised that BONS & GENIEZ (1996) may have judged Mogador to be an improbable location as they marked it on the distribution map with a triangle rather than their usual dots, and no explanation is given. WERNER (1929) "… Mogador (Boettger)" seems to cite BOETTGER (1883) but no mention of this locality was found in Boettger. More likely, Werner is referring to the Boulenger papers quoted above, which he also listed.
Sefrou [6] (WERNER (1929: 14); and reiterated by WERNER (1931b: 289): "near Sefrou south of Fez"	9v1928			WERNER, (1929: 14) gives 9.iv, itinerary (1929: 4) suggests 9.v.
	1iv2004	Sunny, 15°C	500 m N 33°59.320 W 04°57.680	Large-scale agricultural area, mainly orchards. Original habitat probably destroyed.
16.5 km S Sefrou on the road to Boulemane	4 i 1977	Cold wind	N 033°703 W 004°849	CROCHET et al (2004): "found active on the ground among dolomite outcrops with dead grass and sparse dead herbs".
Forest of Sidi el Yamani	early April 1997		30-50 m N 035°365 W 005°985	MATEO et al. (2003), further expounded in CROCHET et al (2004): "in open *Quercus suber* forest on sandy substratum."
Tadlest [12]: (WERNER, 1931a: 237) Tadlest (WERNER, 1931b: 289) [reiterating WERNER (1931a)]	≤21vi1930 (WERNER, 1931a: 254)		2250 m 2250 m	"Doubtful because seen only for a few seconds and not caught." "slopes covered with *Juniperus thurifera* … prickly herbs (*Alyssum spinosum*, *Bupleurum spinosum*, *Astragalus* species etc.)" "in the High Atlas "
Tanger [2] (BOULENGER, 1889) Tanger [2] WERNER (1929) Tanger [2]				"from the vicinity of Tangier" WERNER (1929: 23) "… Tanger (Pellegrin)" but he failed to mention which of the listed seven papers by Pellegrin dealt specifically with *P. microdactylus*. (See text.) GENIEZ et al. (1993) and MATEO et al. (2003): based on specimens in the Paris museum collected by Buchet in 1902.
Taza [5] (WERNER, 1931a,b): "near Taza" and "Taza."	17v1930			"In the bushes of *Chamaerops*."
	28,29iii2004	Rain, 5-9°C	500-1100 m	Wooded mountains, interspersed by lower cultivated fields.
Jbel Tichka (High Atlas) [11]				According to GENIEZ et al. (1993) a locality after WERNER (1931b) who, however, does not mention it. (See text.)
Western part of the Toubkal (High Atlas) [14]				According to GENIEZ et al. (1993) after DE LÉPINEY (1938) [latter item not viewed].
Jbel Zalagh, near Fez [4] (WERNER, 1931b: 289)	23v1930			
	28iii2004	Rainy, intermittently sunny ,13°C	600-750 m N 34°06.347 W 04°58.877	Small mountain range, clearly rising from the surrounding lowland, intensively used for small-scale agriculture. Diverse, mesic habitats.

Table 1. An alphabetical listing, except for the terra typica, of the localities of *Psammodromus microdactylus* described in the literature. Data below the dotted line were collected by us at the locality mentioned above it. The new locality near Azilal mentions our original records. Numbers in square brackets refer to the listing in GENIEZ et al. (1993). Quotation marks indicate passages that were translated from French and German into English.

Fig. 4. Small-scale agriculture at the new locality of *Psammodromus microdactylus* at Azilal.

Photo: H.A.J. in den Bosch

Fig. 5. A Male *Psammodromus microdactylus* at Azilal.

Photo: J. van der Kooij

stones we found, with some regularity, *Timon pater*, *Podarcis vaucheri*, *P. algirus*, and *Teira perspicillata* (as well as various amphibians, skinks, geckoes, agamids, snakes, and many invertebrates), but *P. microdactylus* was never found.

We finally met with success west of Azilal (alt. 1300 m) on April 4th and 5th in an overgrazed pasture (see Fig. 3 and Fig. 4; details in Table 1). On the afternoon of the first day, which was warm and sunny, at around 16h15 a green striped male *P. microdactylus* was noticed walking and basking approximately 40 cm from a stand of *C. humilis* (Fig. 5). I was able to catch it at the first attempt. Our activities soon attracted local attention and with their, initially not appreciated, 'help' of stamping on the Dwarf Palms we saw two more small lizards – most likely *P. microdactylus* – rushing out of one shrub into another where they could not be traced among the jumble of leaves at the base. The sympatric species, *Agama impalearis* (previously *Agama bibronii*, after www.embl-heidelberg.de) was found under nearby stones (Fig. 6). PELLEGRIN (1926) reported for Azilal a higher altitude, 1425 m, with sightings of the following common herpetological species: *Tarentola mauritanica*, *Timon pater*, and *P. algirus*, all of which are probably still to be found there.

After camping close by (minimum night temperature 9°C) we returned the next day at 8h30 and almost immediately I caught a female, apparently already egg-carrying,

Fig. 6. *Agama impalearis* is found sympatrically in the habitat of *Psammodromus microdactylus.*

Photo: H.A.J. in den Bosch

Fig. 7. Female *Psammodromus microdactylus* at Azilal.

Photo: J. van der Kooij

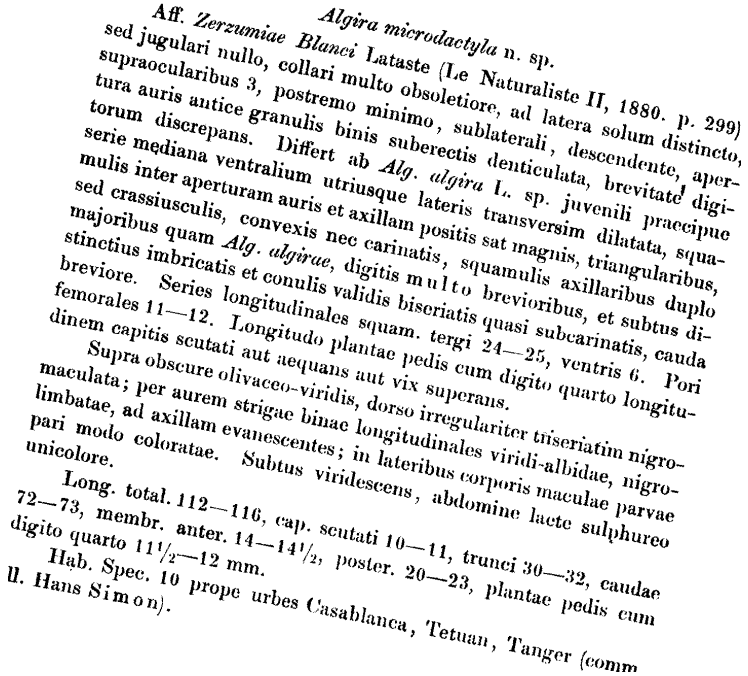
that was basking at the base of a Dwarf Palm. Her green striping was much less intense than of the male (Fig. 7), and dorsally was only faintly present. Additionally, and again with the same type of local help as the day before, four more specimens were seen — three males and one female. Under none of the stones we turned was *P. microdactylus* found, but agamids, large millipedes and centipedes, scorpions, and a variety of coleoptera and ants were encountered. The wet red clay was rather tamped down (by sheep judging from the droppings and tracks) and appeared to provide little in the way of hiding places for lizards. Perhaps this was the reason that *P. microdactylus* kept very close to the *C. humilis* tufts, which at their base offered excellent refugia between the tangled dead leaves with prickly stalks.

The usual tactic for finding lacertids, carefully walking around and spotting basking animals, did not work at all. It was only when locals came to help by irreverently rummaging around the vegetation that more animals turned out to be present. The lizards, when disturbed, dashed to the next bush. From there they were impossible to recover by the many pairs of hands. We stayed to around 11h00, by which time the temperature had risen to 19°C.
While searching, a local declared that two days earlier 1 km west (south of the road) he had seen many more specimens active in a similar terrain. This was after a cold and wet spell with a change to warmer weather. We searched the area with our spokesman until around noon, the temperature quickly reached 29°C, but still not a single specimen turned up.

I collected three faecal pellets from the wild-caught animals mentioned earlier. All three contained a large amount of the same brown-reddish sand/clay as was found in their habitat. This is quite uncommon as a component in the droppings of the Western Palearctic lacertids (e.g. IN DEN BOSCH (1986a), and unpubl. pers. obs.). One pellet contained spider legs and a tiny stone, another included a large mosquito and parts of a small beetle, and the third pellet had legs of a small spider and a small transparent sac-like structure, perhaps the remains of a grub or caterpillar.

VIVARIUM OBSERVATIONS

Starting in the second half of April the two wild-caught lizards were housed in a glass vivarium of 50x30x30 cm whose bottom was covered with peat. Stones, small pieces of wood, some dry leaves (initially from *C. humilis*, but later from other plant material that came with pasture plankton), and a small container with moist potting soil for oviposition were also added to the vivarium. Food (mealworms, buffalo worms, crickets, supplemented by various small locally collected insects), and water containing vitamin AD_3 (40.000 IU A, 20.000 IU D_3) was provided ad libitum.



Algira microdactyla n. sp.

Aff. *Zerzumiae Blanci* Lataste (Le Naturaliste II, 1880. p. 299) sed jugulari nullo, collari multo obsoletiore, ad latera solum distincto, supraocularibus 3, postremo minimo, sublaterali, descendente, apertura auris antice granulis binis suberectis denticulata, brevitate digitorum discrepans. Differt ab *Alg. algira* L. sp. juvenili praecipue serie mediana ventralium utriusque lateris transversim dilatata, squamulis inter aperturam auris et axillam positis sat magnis, triangularibus, sed crassiusculis, convexis nec carinatis, squamulis axillaribus duplo majoribus quam *Alg. algirae*, digitis multo brevioribus, et subtus distinctius imbricatis et conulis validis biseriatis quasi subcarinatis, cauda breviore. Series longitudinales squam. tergi 24—25, ventris 6. Pori femorales 11—12. Longitudo plantae pedis cum digito quarto longitudinem capitis scutati aut aequans aut vix superans.

Supra obscure olivaceo-viridis, dorso irregulariter triseriatim nigromaculata; per aurem strigae binae longitudinales viridi-albidae, nigrolimbatae, ad axillam evanescentes; in lateribus corporis maculae parvae pari modo coloratae. Subtus viridescens, abdomine lacte sulphureo unicolore.

Long. total. 112—116, cap. scutati 10—11, trunci 30—32, caudae 72—73, membr. anter. 14—14½, poster. 20—23, plantae pedis cum digito quarto 11½—12 mm.

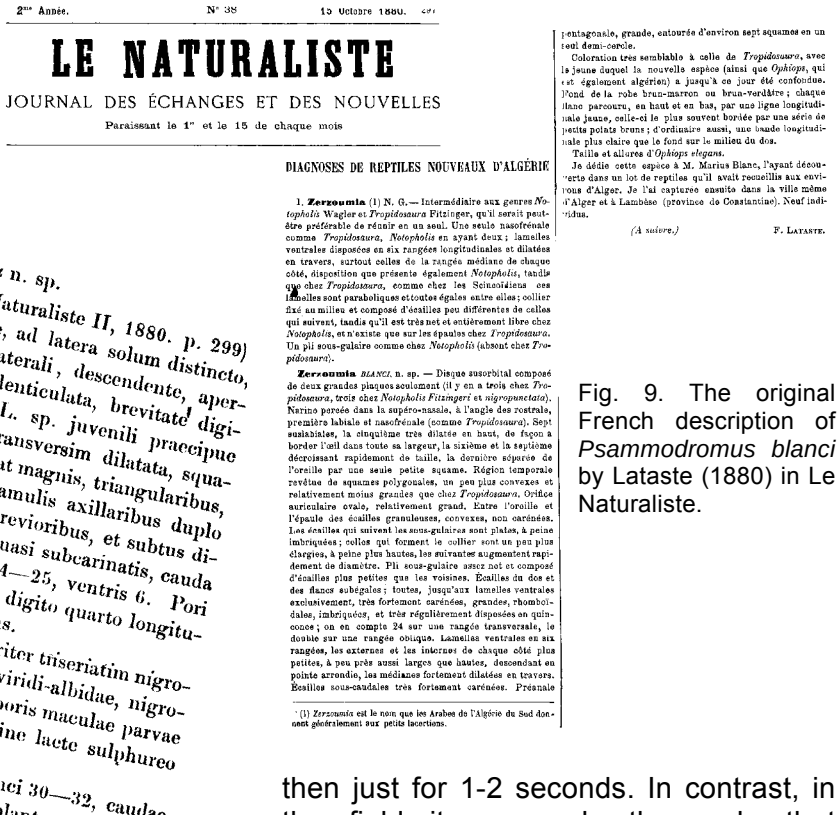
Hab. Spec. 10 prope urbes Casablanca, Tetuan, Tanger (comm

Fig. 8. The original Latin description of *Psammodromus microdactylus* by BOETTGER (1881) in the Zoologischer Anzeiger.

Initially it was always the male that appeared first in the morning, around 8h30, even before the lights were switched on or the sun reached the vivarium. Later on, both lizards appeared more or less simultaneously. Their full-sun basking was done only for a short while (10-20 minutes), then continued under the shelter of the leaves. Later in the day they appeared sometimes for less than a minute on the surface and subsequently disappeared in between the leaves again. When not basking, the animals dug themselves in, often just under the surface, even when temperatures were not exactly high (approx. 20°C). Sometimes they actually basked while dug in. Thus the vivarium with *P. microdactylus* often seemed empty. Given a choice, they rarely would be found under a stone, the preferred hiding place of many other Lacertids.

Both sexes squeak when inadvertently handled too roughly (e.g. for measurements on weight and size), but not habitually and then just for 1-2 seconds. In contrast, in the field it was only the male that squeaked when caught.

Observations on reproductive behaviour, eggs, incubation data, and young will be published in an upcoming paper (In den Bosch, in prep.).



2me Année. N° 38 15 Octobre 1880.

LE NATURALISTE

JOURNAL DES ÉCHANGES ET DES NOUVELLES

Paraissant le 1er et le 15 de chaque mois

DIAGNOSES DE REPTILES NOUVEAUX D'ALGÉRIE

1. **Zerzoumia** (1) N. G. — Intermédiaire aux genres *Notopholis* Wagler et *Tropidosaura* Fitzinger, qu'il serait peut-être préférable de réunir en un seul. Une seule nasofrénale comme *Tropidosaura*, *Notopholis* en ayant deux ; lamelles ventrales disposées en six rangées longitudinales et dilatées en travers, surtout celles de la rangée médiane de chaque côté, disposition que présente également *Notopholis*, tandis que chez *Tropidosaura*, comme chez les Scincoïdiens ces lamelles sont paraboliques et toutes égales entre elles ; collier fixé au milieu et composé d'écailles peu différentes de celles qui suivent, tandis qu'il est très net et entièrement libre chez *Notopholis*, et n'existe que sur les épaules chez *Tropidosaura*. Un pli sous-gulaire comme chez *Notopholis* (absent chez *Tropidosaura*).

Zerzoumia *Blanci*, n. sp. — Disque susorbital composé de deux grandes plaques seulement (il y en a trois chez *Tropidosaura*, trois chez *Notopholis Fitzingeri et nigropunctata*). Narine percée dans la supéro-nasale, à l'angle des rostrale, première labiale et nasofrénale (comme *Tropidosaura*). Sept susiabiales, la cinquième très dilatée en haut, de façon à border l'œil dans toute sa largeur, la sixième et la septième décroissant rapidement de taille, la dernière séparée de l'oreille par une seule petite squame. Région temporale revêtue de squames polygonales, un peu plus convexes et relativement moins grandes que chez *Tropidosaura*. Orifice auriculaire ovale, relativement grand. Entre l'oreille et l'épaule des écailles granuleuses, convexes, non carénées. Les écailles qui suivent les sous-gulaires sont plates, à peine imbriquées ; celles qui forment le collier sont un peu plus élargies, à peine plus hautes, les suivantes augmentent rapidement de diamètre. Pli sous-gulaire assez net et composé d'écailles plus petites que les voisines. Écailles du dos et des flancs subégales ; toutes, jusqu'aux lamelles ventrales exclusivement, très fortement carénées, grandes, rhomboïdales, imbriquées, et très régulièrement disposées en quinconce ; on en compte 24 sur une rangée transversale, le double sur une rangée oblique. Lamelles ventrales en six rangées, les externes et les internes de chaque côté plus petites, à peu près aussi larges que hautes, descendant en pointe arrondie, les médianes fortement dilatées en travers. Écailles sous-caudales très fortement carénées. Présanale pentagonale, grande, entourée d'environ sept squames en un seul demi-cercle.

Coloration très semblable à celle de *Tropidosaura*, avec la jeune duquel la nouvelle espèce (ainsi que *Ophiops*, qui est également algérien) a jusqu'à ce jour été confondue. Fond de la robe brun-marron ou brun-verdâtre ; chaque flanc parcouru, en haut et en bas, par une ligne longitudinale jaune, celle-ci le plus souvent bordée par une série de petits points bruns ; d'ordinaire aussi, une bande longitudinale plus claire que le fond sur le milieu du dos.

Taille et allures d'*Ophiops elegans*.

Je dédie cette espèce à M. Marius Blanc, l'ayant découverte dans un lot de reptiles qu'il avait recueillis aux environs d'Alger. Je l'ai capturée ensuite dans la ville même d'Alger et à Lambèse (province de Constantine). Neuf individus.

(*A suivre.*) F. LATASTE.

(1) *Zerzoumia* est le nom que les Arabes de l'Algérie du Sud donnent généralement aux petits lacertiens.

Fig. 9. The original French description of *Psammodromus blanci* by Lataste (1880) in Le Naturaliste.

ORIGINAL DESCRIPTION

Over the years the distinction between the two evidently closely related North African forms, *P. microdactylus* and *P. blanci,* has repeatedly been the subject of

discussion. No firm conclusion on their status has been reached, probably also due to the scarcity of material of the former. Having had personal experience with both *P. microdactylus* and *P. blanci*, it seemed appropriate to start the morphological taxonomic investigation with the two original descriptions and discuss what has been published since that time. Unfortunately, neither the original diagnoses, nor later pieces of information turned out to be unequivocal.

Boettger described *Psammodromus microdactylus* in 1881 in a Latin diagnosis. A translation will be beneficial for proper comparison with congeners and other species mentioned in the original description, and in discussing some inconsistencies in the diagnosis. Since BOETTGER (1881) compared his new form with LATASTE's (1880) description of *Psammodromus blanci*, the translation of this text is also reproduced here. In the current article, these two descriptions are compared and analysed using my personal live and alcohol-preserved material, and characters used in later literature are also reviewed.

In advance, it will be useful to explain the older names and add a synonymy for *P. microdactylus*. Currently we know *Algira microdactyla* as *Psammodromus microdactylus* (Boettger, 1881). *Zerzoumia blanci* (as in LATASTE, 1880: 299) and the (apparently German-like phonetically and partly inflected) written *Zerzumiae Blanci* Lataste (BOETTGER, 1881: 571) is now called *Psammodromus blanci* (Lataste, 1880). *Alg. algira* L. and *Alg. algira*, both correspond to *Psammodromus algirus* (Linnaeus, 1758).

The comparisons in the diagnoses with *Notopholis* (*Notopholis Fitzingeri* = *Algyroides fitzingeri* (Wiegmann, 1834)), *Notopholis nigropunctata* = *Algyroides nigropunctatus* (Duméril & Bibron, 1839)) and *Tropidosaura* (here: *Psammodromus algirus* (L., 1758)) are because LATASTE (1880) described his new genus *Zerzoumia* – with *Zerzoumia blanci* as new species – as being intermediate between these two genera.

When naming his genus *Zerzoumia*, LATASTE (1880) explained the etymology as "le nom que les Arabes de l'Algérie du Sud donnent généralement aux petits lacertiens" [the name commonly used by the Arabs of southern Algeria for small lacertids]. Remarkably, according to BOULENGER (1891) reference was made to *P. blanci* even earlier as The Zermoumeah in 'Shaw, J., 1738. Travels, or observations relating to several parts of Barbary and the Levant. Oxford', before it was scientifically described.

Synonymy *Psammodromus microdactylus* (BOETTGER, 1881)

Algira microdactyla n. sp. – BOETTGER, 1881: 571.
Algira (*Zerzumia*) *microdactyla* Bttg. – BOETTGER, 1883: 19.
Psammodromus microdactylus – BOULENGER, 1887: 49.
Psammodromus microdactylus, Bttg. – BOULENGER, 1889: 304.
Algira microdactyla, sp. n. (*Psammodromus*) – BOULENGER, 1891: 103.
Psammodromus microdactylus, Boettger, 1881 – BOULENGER, 1891: 127.
Psammodromus microdactylus Böttg. – DOUMERGUE, 1901: 139.
Psammodromus microdactylus – BOULENGER, 1921: 173.
Psammodromus microdactylus Bttgr. – WERNER, 1929: 14, 23.
Psammodromus microdactylus Bttgr. – WERNER, 1931a: 237.
Psammodromus microdactylus Btgr. – WERNER, 1931b: 289.
Psammodromus microdactylus (Boettger) – PASTEUR & BONS, 1960: 76.
Psammodromus microdactylus (Boettger) – BONS & GIROT, 1962: 29.
Psammodromus microdactylus (Boettger, 1881) – BONS, 1972: 114.
Psammodromus microdactylus (Boettger, 1881) – MELLADO & DAKKI, 1988: 175.
Psammodromus microdactylus (Boettger 1881) – GENIEZ, GENIEZ, BOISSINOT, BEAUBRUN & BONS, 1991: 21.
Psammodromus microdactylus – GENIEZ, CROCHET & MATEO, 1993: 15.
Psammodromus microdactylus Boettger, 1881 – SCHLEICH, KÄSTLE & KABISCH, 1996: 452.
Psammodromus microdactylus (Boettger 1881) – BONS & GENIEZ, 1996: 144.
Psammodromus microdactylus Boettger, 1881 – MATEO, PLEGUEZUELOS, FAHD, GENIEZ & MARTINEZ-MEDINA, 2003: 169.
Psammodrumus microdactylus – MATEO, PLEGUEZUELOS, FAHD, GENIEZ & MARTINEZ-MEDINA, 2003: 171.
Psammodromus microdactylus (Boettger, 1881) – CROCHET, SWEET & MATEO, 2004: 184.

For better understanding of the enumerative aspect of the '*Algira microdactyla*' description, many commas have been replaced by semicolons in the English translation. The footnotes refer to the comments listed below.

For comparative purposes, alcohol specimens were used: three *P. blanci*, three *P. hispanicus*, two *P. algirus*, one A. *fitzingeri*, and one *A. nigropunctatus* (see Appendix I for origin of material). For the European species I used the Handbuch series to check that the data fell well within the ranges known for the measured characteristics. The four *P. microdactylus* (one wild-caught pair, one captive-bred pair) were examined alive.

The following description is the English translation of BOETTGER's (1881) diagnosis of *Psammodromus microdactylus*.

Fig. 10. Female *Algyroides fitzingeri* (Sardinia).

Photo: H.A.J. in den Bosch

Fig. 11. A pair of *Algyroides nigropunctatus*.

Photo: H.A.J. in den Bosch

Fig. 12. Male *Psammodromus algirus* (Spain) in courtship coloration.

Photo: H.A.J. in den Bosch

Fig. 13. Male (head visible) and female (with bite marks of copulation grip on her back) *Psammodromus hispanicus* (Portugal).

Photo: H.A.J. in den Bosch

Fig. 14. Male *Psammodromus blanci* (Algeria).

Photo: H.A.J. in den Bosch

Fig. 15. Young female *Psammodromus algirus* (Spain).

Photo: H.A.J. in den Bosch

Algira microdactyla n. sp.

Related to *Zerzumia Blanci* Lataste (Le Naturaliste II, 1880. p. 299), but differing in the following aspects: the gular fold is missing[1]; the collar is much more inconspicuous, and only discernible laterally[2]; there are three supraoculars[3], the posterior and smallest descends laterally; the ear opening is serrated frontally because of two slightly erected granular scales[4]; the short digits. Some of the character differences from juvenile *Alg. algira* L. are: the middle row of ventrals on both sides[5] are horizontally widened; the scales between the ear opening and axilla are fairly large, triangular, and more thickened, convex but not keeled; the axillary scales are twice as large in *Alg. algira*[6]; the digits are much shorter and the scales underneath them are more distinctly imbricated and arranged as sturdy cones in double rows, seemingly keeled[7]; the shorter tail. The dorsal scales are in 24-25 longitudinal rows[8], the ventral scales in six rows. Femoral pores 11-12[9]. The length of the sole of the foot plus the fourth toe equals the length of the pileus or is barely longer[10]. Dorsally dark olive green, on the back there are three irregularly formed rows of black spots[11]; along the ear there are two white-green longitudinal stripes, fringed with black, disappearing at the groin; on the flanks small spots of a similar colour. Underneath tending to green[12], while the belly is a uniform lively yellow.

Total length 112-118 mm, length of the pileus 10-11 mm, of the body 30-32 mm, of the tail 72-73 mm, of the front legs 14-14½ mm, hind legs 20-23 mm, of the sole of the foot including the fourth toe 11½-12 mm.[13]

Ten specimens were available from the area of the cities Casablanca, Tetuan, Tanger (according to Hans Simon).

Remarks

This description is repeated almost verbatim in BOETTGER (1883), with the form there called *Algira* (*Zerzumia*) *microdactyla* Bttg. – and not as BOULENGER (1891: 103) reported: *Algira microdactyla* sp. n. Differences between the two texts are found in the spelling of '*Alg. algira* L.' which becomes 'Alg. Algira L.'; '…squamulis inter aperturam auris…' becomes '…squamis inter aperturam auris…'; '*Alg. algirae*' becomes 'A. Algirae'; '…digitis multo brevioribus, et subtus distinctius imbricatis…' becomes '…digitis multo brevioribus, et subtusque distinctius imbricatis…'; 'Series longitudinales squam. tergi 24-25, …' becomes 'Series longitudinales squamarum tergi 24-25, …', and finally 'Casablanca' is omitted as a locality. BOETTGER (1883) further added that in one of the specimens the occipital is missing, and when present it is always narrower than in *P. algirus* of comparable size. As well, the frontonasals in the new species are somewhat longer. The coloration he stated as a nice dark olive green to olive brown, the black dorsal spots – always the size of a full scale – are sometimes arranged in three longitudinal lines, sometimes irregularly and sparingly dispersed, sometimes (mainly in the more brown coloured specimens) fairly dull and only weakly developed.

1) 'sed jugulari nullo' is here translated as 'the jugular fold is missing'. This is confirmed by the use of the German word 'Jugularfalte' by BOETTGER (1883: 21). BOULENGER (1891) also spoke of "No gular fold…". The character is probably used because in the French description of the related *P. blanci* by LATASTE (1880) it is mentioned to possess a "Pli sous-gulaire assez net et composé d'écailles plus petites que les voisines" [Gular fold quite clear and composed of scales smaller than their neighbouring ones].
   Surprisingly, well-known herpetological dictionaries (KABISCH, 1990; PETERS, 1964) make no mention of 'jugular fold' or 'Jugularfalte', and curiously enough define 'gular fold' as a "transverse fold of skin across the throat immediately anterior to the insertion of the forelegs". Because in Lacertidae that is where we find the collar, a gular fold in this family would automatically become syntopic with the collar (though this collar may be fairly indistinct in the genus *Psammodromus* and even absent in *P. algirus*). Collar, in the sense of gular fold, is, according to PETERS (1964), often used in descriptions of the not closely related Teiid lizards. More logically, in the present context where the jugular fold and collar are discussed separately and are different morphological fea-

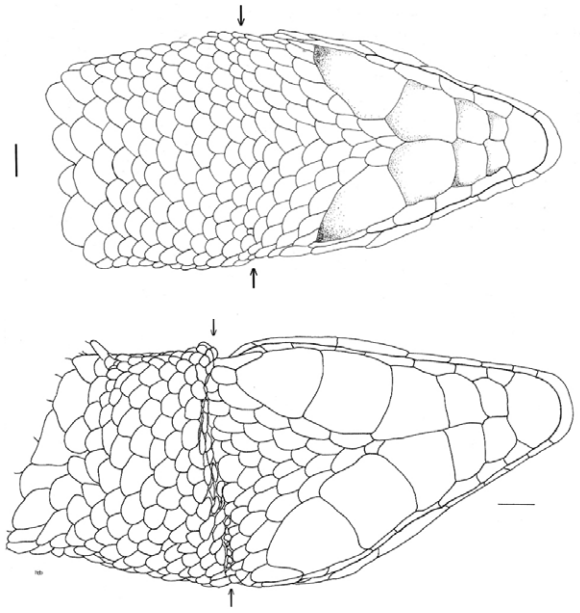


Fig. 16. Gular region of *Psammodromus hispanicus* (adapted from Handbuch 1(I): fig. 89), top, and *Algyroides moreoticus* (drawing H.A.J. in den Bosch), bottom. Arrows indicate the region of the gular fold. Scale: 1 mm.

tures, the 'jugular fold' / 'pli sous-gulaire' / 'gular fold' is the transverse fold found under the throat of many lacertids running more or less from ear opening to ear opening. This fold is indeed often hardly more than a series of smaller scales. See e.g. the drawing by SALVADOR (1981) of *P. hispanicus* (Fig. 16) and of other lacertids in that Handbuch tome and later volumes. Even more confusing is that the jugular fold is not absent in my four *P. microdactylus*.

2) All four of my *P. microdactylus* lack a collar. The diagnosis for *P. blanci* says: "…collier fixé au milieu et composé d'écailles peu différentes de celles qui suivent, tandis qu'il est très net et entièrement libre chez *Notopholis*, et n'existe que sur les épaules chez *Tropidosaura*." […collar attached in the middle and composed of scales only slightly differing from the following, whereas it is fully free in *Notopholis* [=*Algyroides fitzingeri*], and exists only near the shoulders in *Tropidosaura* [=*Psammodromus algirus*].] This is a correct statement for these three species judging from my material. In *P. hispanicus* the collar is present and free.
3) Diagnosis *P. blanci*: "Disque susorbital composé de deux grandes plaques seulement (il y en a trois chez *Tropidosaura*, trois chez *Notopholis fitzingeri* et *nigropunctata*)" [Two large supraoculars (there are three in *Tropidosaura* [=*Psammodromus algirus*], three in *Notopholis fitzingeri* [=*Algyroides fitzingeri*] and *nigropunctata* [=*Algyroides nigropunctatus*]]. All of this is different in the material available to me: my four *P. microdactylus* show four supraoculars (two large ones, a small descending posterior one, and an even smaller anterior one), rather than the stated three; two of my *P. blanci* show a similar constellation and one has three supraoculars; there are three or four supraoculars in *P. algirus*; four in *A. fitzingeri*; and two or three in *A. nigropunctatus*. The constellation in *P. hispanicus* is similar to that in *P. microdactylus*. BOULENGER (1921) also reported four supraoculars in both *P. blanci* and *P. microdactylus*.
4) There are not 2 "slightly erected granular scales" in my four *P. microdactylus* but rather 3-6 larger scales and an additional 0-4 smaller scales, all forming a kind of anterioventral quarter ring around the ear opening. The situation in my *P. blanci* is comparable, albeit with 1-3 larger scales and 1-2 smaller ones. In *P. hispanicus* there are 4-6 subequal scales with a somewhat larger section of the quarter circle. *P. algirus* has 3-5 subequal, quite sunken scales. *A. fitzingeri* is different in that it has an anterior semi-circle of 8-9 subequal scales. A comparable situation is found in *A. nigropunctatus*, though here the scales are much flatter and line the anterior rim more from the inside as the ear opening is quite sunken.

Fig. 17. Ventrals in *Psammodromus algirus* (left), *Psammodromus blanci* and *Psammodromus microdactylus* (right, with the narrowed ventrals shaded). (Adapted from BONS & GIROT (1962).)

5) This is a convoluted way of saying that the ventrals of both outer rows and the two median rows are narrowed as compared to row 2 and 5 (see Fig. 17). Narrower median ventrals separate *P. microdactylus* from *P. algirus* (where the ventrals are all subequal), but not from *P. blanci* that has an arrangement identical to *P. microdactylus*. A fairly similar constellation is found in *P. hispanicus*: the scales in the two median rows are narrower than the neighbouring ones, those in the outer row are much narrower. In *A. fitzingeri* the median ventrals are slightly narrower, and the outer ones are much narrower. In *A. nigropunctatus* the median and outer ventrals are equally narrow, those in the semi-outer row are 1.5-2x as wide. In his diagnosis of the genus *Zerzoumia*, LATASTE (1880) reported on the ventrals in a complex manner similar to BOETTGER's (1881) discussion of the ventrals of *P. microdactylus*: "lamelles ventrales disposées en six rangées longitudinales et dilatées en travers, surtout celles de la rangée médiane de chaque côté,…" [ventrals in six rows; dilated crosswise, especially those of the median row on each side], while his diagnosis of the species *Zerzoumia blanci* said the same thing in a somewhat different way "Lamelles ventrales en six rangées, les externes et les internes de chaque côté plus petites, à peu près aussi larges que hautes, descendant en pointe arrondie, les médianes fortement dilatées en travers" [Ventrals in six rows; smallest ones in the two most lateral rows of each side, of more or less similar width and height, with posterior edges rounded; those in the median rows are strongly dilated]. It thus appears that both LATASTE (1880) and BOETTGER (1881) considered the belly of the lizards to consist of a left and a right side and described the ventrals accordingly.

6) This statement recurs in BOETTGER (1883). Although true for *P. algirus* where those scales are large, pointed and most are keeled, there is little difference between *P. microdactylus* and *P. blanci* concerning those scales on the side of the neck. The diagnosis of *P. blanci* holds: "Entre l'oreille et l'épaule des écailles granuleuses, convexes, non carénées" [Between the ear and the shoulder, granular scales, which are convex and not keeled]. Again, the situation in *P. hispanicus* is almost similar, although that species seems to have a larger percentage of more pointed scales.

7) "Much shorter digits" in *P. microdactylus* as contrasted to juvenile *P. algirus* has little relevance, except perhaps when comparing individuals of identical body length. An index of some kind, or exact lengths of the digits of *P. algirus* would be preferable to allow for comparison with the data on *P. microdactylus*, but none is given. Nothing is said in the description of *P. blanci* concerning digits. Similar remarks can be made concerning the length of the tail. The epitheton specificum thus refers to a contrast with juveniles of the already quite dissimilar *P. algirus*, not – as one might assume – from a comparison with the more related *P. blanci*. Curiously, two years later BOETTGER (1883) added [translated]: "Lataste [=LATASTE (1881)] did not regard the development of the toes of his *Zerzumia* [sic.: referring to *Zerzoumia blanci*] as peculiar. From this I must assume that the short and stocky build of the toes, which are covered ventrally with much more protruding imbricately placed scales and a strong, obtusely conical, horny elevation on both sides, which makes it in a sense interruptedly doubly keeled, are typical for our Moroccan species [=*P. microdactylus*]. Viewed laterally the toes are much more coarsely denticulated as seen in *Algira subgen. Tropidosaurus* [=*P. algirus*]". With this he suggested post-factum to have named the species because of its remarkable toes in comparison with *P. blanci*. This is false. Again, using my own material of *Psammodromus*, I cannot agree on the different toe development as both *P. blanci* and *P. microdactylus* have tubercular, dark brown, practically identical unkeeled subdigital lamellae in more or less two rows. There is also no keeling present in BOETTGER's (1883) plate 1, 2e: see Fig. 18. Actually, it is *P. hispanicus* that shows very dissimilar pointed, protruding, and trans-

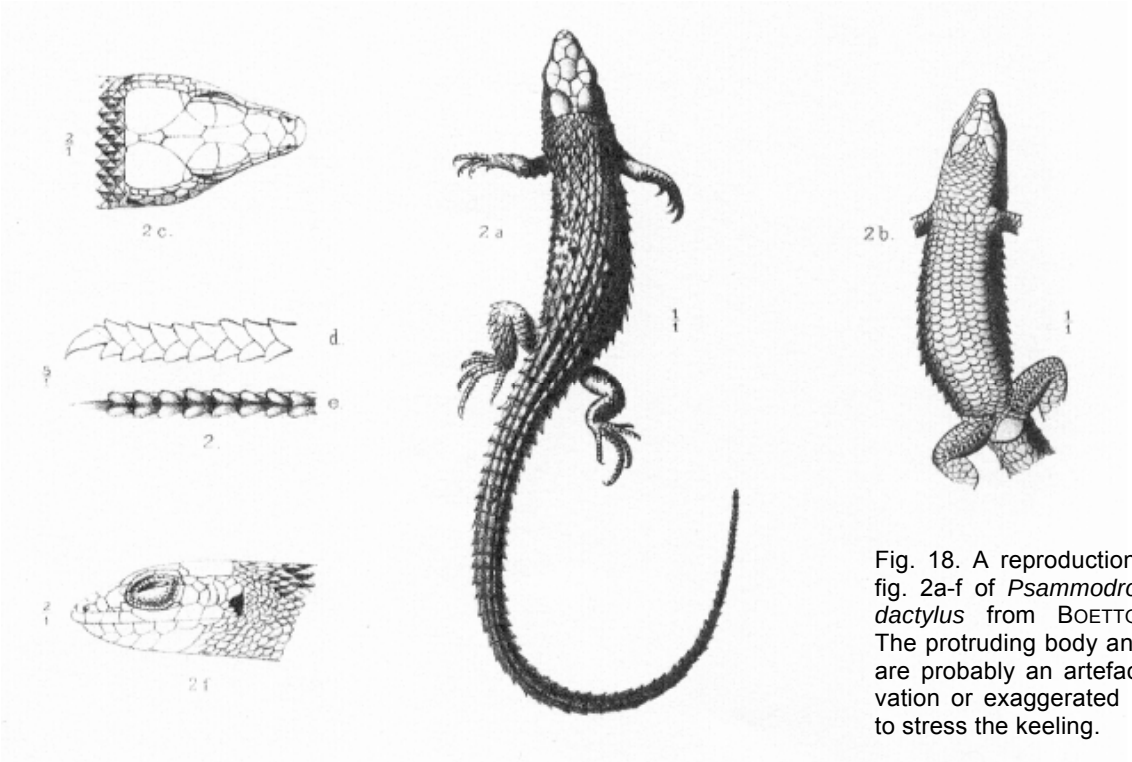


Fig. 18. A reproduction of plate 1, fig. 2a-f of *Psammodromus microdactylus* from BOETTGER (1883). The protruding body and tail scales are probably an artefact of preservation or exaggerated by the artist to stress the keeling.

parent subdigital lamellae (Fig. 19). This spinulose scutellation BOULENGER (1921) already saw as "an adaptation to the sandy localities it frequents", although ARNOLD (1973) suggested that such keels reduce the heat flow from hot substrates. The drawing in SCHLEICH et al. (1996: 452) for *P. microdactylus* shows pronounced keeling (Fig. 20), but without reference to a museum specimen it is likely drawn after BOETTGER's (1883) description, rather than from the type specimen. *P. algirus* has pointed ones in a single row (Fig. 21).

8) My four *P. microdactylus* show 22-24 dorsal rows, similar to *P. blanci* (the diagnosis of *P. blanci* indicates 24 rows). My *P. hispanicus* have 28-37 dorsal rows (SALVADOR (1981): 30-42), the *P. algirus* 22-24 (BÖHME (1981): 22-28).
9) BOETTGER (1883: 21) added – in comparison with *P. algirus* – that the low number of femoral pores distinguished the new species. There are no data concerning femoral pores in the original description of *P. blanci*. My four *P. microdactylus* have 12-13 femoral pores on each side, my *P. blanci* show 10-12, *P. hispanicus* 10-15 (SALVADOR, 1981: 9-15), and *P. algirus* has 13-21 (BÖHME, 1981).

Fig. 19. Subdigital lamellae in *Psammodromus hispanicus* (source: Handbuch 1(I): fig. 90). Scale: 1 mm.

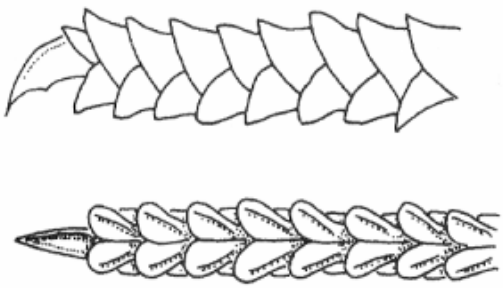


Fig. 20. Subdigital lamellae in *Psammodromus microdactylus* as depicted in SCHLEICH et al. (1996).

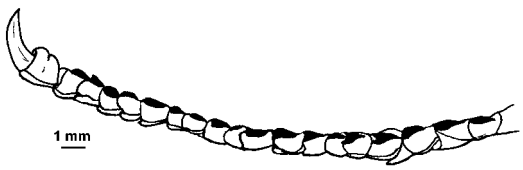


Fig. 21. Subdigital lamellae in *Psammodromus algirus*.

Drawing: H.A.J. in den Bosch

10) In my four *P. microdactylus* foot sole + fourth toe measure 9-11 mm, the pileus 10.5-11.5 mm, making the measurements about equal. No data concerning foot sole + fourth toe with respect to the pileus were included in the description of *P. blanci*. In my *P. blanci* these data are 9-10 mm and 9.5-10 mm respectively, in *P. hispanicus* 10-13 mm and 8.5-11.5 mm, in *P. algirus* 16-16.5 mm and 16-18 mm. The latter weakens the argument of BOETTGER (1883) that the foot sole + fourth toe is always much longer than the pileus in that species, a character he used to distinguish between *P. microdactylus* and *P. algirus*.
11) The wild-caught male was dorsally a striking green colour and showed three rows of dark spots on the flank (strictly speaking therefore not on the back; with some difficulty one could thus discern six such rows dorsally). An additional irregular dotted black line can be distinguished lateroventrally in the male. In the younger male these rows contain significantly fewer black dots and hardly form a series. In one female only, a row above the lighter coloured lateral streak is found, in the other female a row along the dorsolateral line can be discerned. BOULENGER (1889, 1891) noted "with or without brown or black spots, which may be mixed with white". BOETTGER (1883) added [translated, and in comparison with *P. algirus*]: "the absence of blue ocelles in the shoulder region" is characteristic.
For *P. blanci* LATASTE (1880) wrote [translated]: coloration quite like *P. algirus* (and *Ophisops*), background chestnut brown or greenish brown; along each flank, above and below, a yellow stripe, which is often bordered by a series of small brown spots; usually also a vertebral band, coloured much lighter than the rest of the back.
12) In the phrase "Underneath tending to green" the question arises as to what 'underneath' is actually referring to, especially as "the belly is a uniform lively yellow".
13) The original description of *P. blanci* indicated [translated]: Size and appearance like *Ophiops* [now *Ophisops*] *elegans*. See Table 2 for a comparison of head-body and tail lengths of the three smaller *Psammodromus*. Total length of my *P. microdactylus* is 126-148 mm, which is longer than the original 112-118 mm; 108-124 mm in my *P. blanci*. A confusing remark in BOETTGER (1883) concerns [translated]: "The length of the tail [compared to the body? HidB] in *A. microdactyla* is in the proportion of 1:1.57, however in Moroccan specimens of *A. Algira* it is 1:1.44, a figure that will probably decrease when more complete specimens of the latter become available". Using his own data, 1:1.75 seem more likely for *P. microdactylus* (thus perhaps being a simple typo), but for *P. algirus* using general data from BÖHME (1981) 1:2.8 would be expected. Furthermore, my measurements give 1:1.6-1:2.2 for *P. microdactylus* and 1:1.7-1:2.0 for *P. blanci*, and actually show little if any disparity between those species. In BOULENGER (1887) we find for P. *blanci*: Tail once and a half to once and three fourths as long as head and body [1.5-1.75]; and for P. *microdactylus*: Tail once and two thirds as long as head and body [1.66].

Species	Head-body length	Tail length
P. blanci		
male	46	86
female	47	78
P. hispanicus		
male	48	95
female	53	89
P. microdactylus		
male	49	99
female	48	85

Table 2. Maximum head-body and tail sizes (in mm) of the three smaller *Psammodromus* species using my own material and BISCHOFF & IN DEN BOSCH (1991).

In summary, this means that the statements in the original description (BOETTGER, 1881) of *P. microdactylus* concerning the gular fold (1), supraoculars (3), and scales near the ear opening (4) are false in comparison with my material. The remarks on the collar (2), and green dorsal coloration (11) are true and distinguish it from *P. blanci*. All the other characters (on ventrals (5), axillary scales (6), digits (7), dorsals (8), femoral pores (9), feet and pileus (10), rows of dark spots (11), and measurements of body and

appendage lengths (13)) are accurate, but only relevant to differentiate *P. microdactylus* from the much larger *P. algirus*, not from *P. blanci*. The remark on ventral coloration (12) is simply confusing.
A broad conclusion concerning the above remarks is that many of the inconsistencies can be explained on the basis of the knowledge and assessments made over a century ago. The comparisons with several species now obviously in other genera, and with *P. algirus* presently so well-known and unmistakably different that confusion seems highly improbable (although MATEO et al. (2003) still deem a mix-up with young *P. algirus* possible, but remarked these have a much longer tail, show no collar or gular fold, and have keeled scales on the side of the neck), do not particularly clarify the positions of *P. microdactylus* and *P. blanci*. Apart from the indication on green dorsal and ventral yellow coloration, and the statement on the very poorly developed collar, the original description of *P. microdactylus* has little diagnostic value, and does not help to distinguish it from *P. blanci*.

LATER LITERATURE

After the original descriptions of *P. blanci* and *P. microdactylus,* it was VON FISCHER (1887) who first published on *P. blanci*. He kept both *P. blanci* and *P. algirus* in captivity and inexplicably insisted that both species were – apart from size – so similar that they were at first sight indistinguishable. Next BOULENGER (1887, 1889, 1891, and later 1921) added remarks on colour, sizes, pholidosis, and taxonomy. Between him and the brothers Vaucher, one of whom was an avid collector, correspondence on *P. microdactylus* was carried on (photocopies of the latter writing to the Belgian herpetologist were made available to me, Boulenger obviously hoping to get more lizard material). In the beginning of the 20th century DOUMERGUE (1901) added his observations on the species. About thirty years later WERNER (1929, 1931a, b) collected specimens and added valuable field observations. A long silence ensued, broken in the sixties by Bons and his French collaborators. Another thirty years passed before several French, Spanish and German authors (e.g. GENIEZ et al., 1993; MATEO et al., 2003; SCHLEICH et al.,1996) became interested in *P. microdactylus*. Slightly earlier IN DEN BOSCH (1986b) and BISCHOFF & IN DEN BOSCH (1991) published on the biology of *P. algirus*, *P. blanci* and *P. hispanicus*.
The original descriptions of *P. blanci* and *P. microdactylus* do not clearly differentiate between these two forms. Unfortunately, several of the later works mentioned above do not help sort out this issue, and actually contribute further to the problem. By summarising the various aspects I hope to sort out the puzzling disorder and clarify the underlying causes of this confusion.

Psammodromus blanci — Psammodromus microdactylus

Data for *P. blanci - P. microdactylus* have been repeatedly contrasted in the literature, but never evaluated critically. SCHLEICH et al. (1996), for example, treated both forms as sibling species for "practical reasons" and stated that colour pattern, as emphasised by DOUMERGUE (1901) and PASTEUR & BONS (1960), would be the most reliable feature for discriminating between the two. Next, they proceeded with the following chart (Table 3) without indicating their sources, thereby giving the improper impression of presenting new data. I have added in these sources and some personal comments.

Table 3. Modified table from SCHLEICH et al. (1996) comparing "the main morphological differences" between *P. blanci* and *P. microdactylus*. I have added two characters from their descriptive text and some personal annotations.

Character	*P. blanci*	*P. microdactylus*	Comments
gular fold	more or less distinct [LATASTE, 1880]	absent [BOETTGER, 1881]	Incorrect: present in my four *P. microdactylus* (cf. Figs. 22, 23).
collar	distinguishable [LATASTE (1880): [translated] "attached in the middle."]	none [BOULENGER, 1887]	Correct, though collar at times hardly recognisable in *P. blanci* (cf. Figs. 22, 23).
colour above	olive or pea green [From BOULENGER's (1889) description of *P. microdactylus* (!): "in fresh specimens varies from pea-green to olive", repeated in Boulenger (1891).]	olive or bronzy brown [From BOULENGER's (1891) description of *blanci* (!): "Olive or bronzy brown above".]	Incorrect and both species are confused; although SCHLEICH et al. (1996) report in-text for *P. blanci* "brown, in TUN [=Tunisia] greenish", they also mention for *P. microdactylus* "green or dark olive with a bluish hue". Besides, coloration is seasonally dependent.
lateral stripes	two yellowish streaks on each side [LATASTE (1880: [translated] "along each flank, above and below, a yellow stripe, which itself is often bordered by a row of small brown spots."] sometimes a light vertebral line [LATASTE (1880): [translated] "usually also a vertebral band, coloured much lighter than the rest of the back."]	one brown or reddish streak on each side [From BOULENGER (1889), also in BOULENGER (1891): "a more or less distinct brown or reddish lateral band is constantly present."]	Correct, but comparing different lines: there is a brown lateral band in *P. microdactylus* (it is more grey in *P. blanci*), but it is also bordered by two lighter streaks (sex and season dependent being green to yellowish white): cf. Fig. 1 [summer] and Figs. 27, 29. Thus no help, just more chaos.
ventral side	white, outer row of ventrals lemon-yellow, throat of male bluish [From BOULENGER's (1889) description of *P. microdactylus* (!): "lower surfaces white, outer row of ventrals lemon-yellow; throat of males bluish" also in BOULENGER (1891). Earlier, BOULENGER (1887) stated for *P. blanci* (in error, I think) "lower surfaces yellowish".] [DOUMERGUE (1901) reported [translated]: "off-white or greenish", and "in a male in the mating season: base of the flanks a golden yellow stretching over the 2nd, 3rd, and 4th ventral rows. Bands and side of the tail yellow." PASTEUR & BONS (1960) said the belly was white or a greenish mother-of-pearl.]	uniformly yellowish [BOULENGER (1887) for *P. blanci* (!): "lower surfaces yellowish."] or whitish with bluish hue [PASTEUR & BONS (1960) [translated]: "Belly: matt white more or less bluish." Similar remarks prior in DOUMERGUE (1901); these authors probably working with preserved material.]	At least partly incorrect; moreover, the belly of my wild-caught male *P. microdactylus* is white, outer row of ventrals is lemon-yellow. Again, both species are confused. BISCHOFF & IN DEN BOSCH (1991) considered the ventral parts of *P. blanci* mother-of-pearl coloured, parts of the throat and outer ventrals often yellowish.
identification (in-text)	body 2-2½x distance snout-collar [After DOUMERGUE (1901), BOULENGER (1921), and PASTEUR & BONS (1960).] striking light pattern of 4 longitudinal stripes on brown ground colour [Partly after DOUMERGUE (1901) [translated]: "2 or 4 grey or yellow, well-marked bands", who probably repeated LATASTE (1880).]	body not 2x distance snout-collar [After DOUMERGUE (1901), BOULENGER (1921), and PASTEUR & BONS (1960).] without [After DOUMERGUE (1901: 132) [translated]: "always without coloured bands."] or with two light dorsal stripes [Perhaps after BONS & GIROT (1962: 29).]	In my sample only a modest size discrepancy (see Table 4, remark 12). Stripes: see comment above on 'lateral stripes'.
sexual dimorphism: (in-text)	hindlegs plied forward reach axilla in males, but not as far in females [From BOULENGER (1887): "The adpressed hind limb reaches the axilla in the male, not so far in the female".] [BOULENGER (1921): "The hind limb reaches wrist or elbow of the adpressed fore limb in females, the axil, the shoulder, the collar or a little beyond in males." Or perhaps from WERNER (1931b) [translated]: "The hind limb reaches wrist or fingertips in females, the elbow in males".]	if forelegs and hindlegs are plied toward each other, the longest toe reaches the elbow in males, but only the wrist or fingertips in females [Seemingly partly after BOULENGER (1887): "The adpressed hind limb reaches, or nearly reaches the axilla", and BOULENGER (1921): "The hind limb reaches the elbow of the adpressed fore limb or the axil in females, the axil in males".]	Correct for both species, although comparing somewhat different characters, and again a mishmash of literature data on the two species.

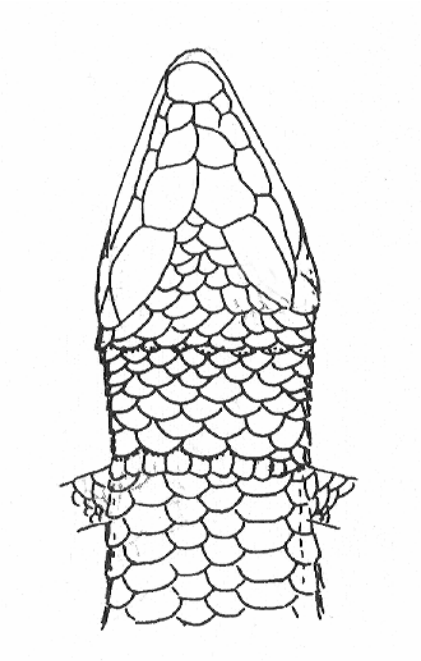


Fig. 22. *Psammodromus blanci* as depicted in SCHLEICH et al. (1996) where it is described as "with gular fold and distinguishable collar".

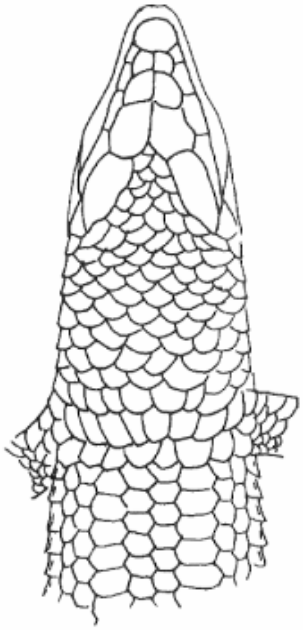


Fig. 23. *Psammodromus microdactylus* as depicted in SCHLEICH et al. (1996) where it is described as "without gular fold and collar". This is not the case in my *P. microdactylus* that have a gular fold.

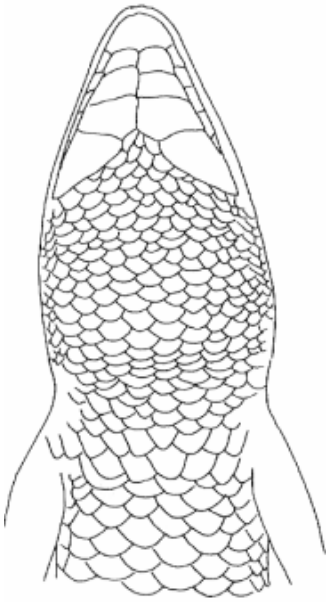


Fig. 24. *Psammodromus algirus* as depicted in SCHLEICH et al. (1996). The gular fold and collar are absent.

Fig. 25. Males of the common lacertid *Podarcis vaucheri* are also green during the reproductive season and could be confused with *Psammodromus microdactylus* by the casual observer.

Photo: H.A.J. in den Bosch

This example epitomises the bewildering disarray of character states used in the discussion on the forms *P. blanci* and *P. microdactylus* and the rather unnecessary additional slip-ups caused by transcription errors.

Further characteristics used in literature to differentiate *P. blanci* and *P. microdactylus* are reviewed in Table 4 through their application to the four specimens from Azilal. Footnotes are included with some annotations and discussion of relevant citations.

Psammodromus microdactylus	wild-caught (in 2004) male	wild-caught (in 2004) female	male born 2004	female born 2004
collar[1]	absent	absent	absent	absent
gular fold[2]	present	present	present	present
granular scales on side of the neck[3]	slightly granular, most are pointed	granular, most are rounded	granular, most are pointed	granular, most are pointed
colour back[4]	brown, longitudinal stripes beige	light brown, faint beige longitudinal stripes	light brown, contrasting beige longitudinal stripes	light brown, longitudinal beige stripes less pronounced
colour belly[5]	white, outer row of ventrals yellow	white	white	white
hind leg, when stretched along body, reaches …[6]	sole reaches wrist, 4th toe elbow	sole reaches finger tips	sole reaches wrist, 4th toe elbow	sole reaches finger tips
upper caudal scales more strongly keeled than the dorsals[7]	slightly	slightly	no	yes
lower eyelid with (*P. blanci*) or without (*P. microdactylus*) a central series of vertically elongated strongly enlarged scales[8]	without	without	without	without
subdigital lamellae[9]	smooth, tubercular, very dark brown	smooth, tubercular, very dark brown	smooth, tubercular, very dark brown	smooth, tubercular, very dark brown
head and neck relatively slender or relatively stout[10]	relatively massive	relatively massive	relatively massive	relatively massive
index body length / snout-collar length[11]	32÷17=1.9	36÷15=2.4	28÷15=1.9	32÷14=2.3
the ratio distance snout-collar / collar-anus[12]	17/31 (0.55)	15/36 (0.42)	15/29 (0.52)	14/32 (0.44)
suture between the rostral and the first labial falls below the anterior border of the nostril or below the centre of the nostril[13]	below the centre of the nostril	below the centre of the nostril	below the anterior border of the nostril	below the centre of the nostril
number of dorsals[14]	24	23	22	24
ventrals: subequal, or median and outer row narrower[15]	median and outer row narrower	median and outer row narrower	median and outer row narrower	median and outer row narrower
breast scales of the first row rectangular, clearly longer than wide, oblique, or breast scales of the first row almost square, oblique, but not clearly different in size from preceding collaria[16]	approximately triangular	almost square, oblique, not clearly different from preceding collaria	almost square, oblique, not clearly different from preceding collaria	almost square, not clearly different from preceding collaria
ventrals a little imbricate, at right angles or almost so, or: ventrals sometimes with convex borders[17]	generally more right-angled	mainly distally convex	mainly distally convex	mainly distally convex
femoral pores (l / r)[18]	13/12	13/13	13/13	13/13
4th toe: number of subdigital lamellae[19]	15 [tip of toe missing]/17	18/-- [toe missing]	19/18	17/19

Table 4. Measurements of 'distinguishing' characters of the four adult *Psammodromus microdactylus* as employed in the literature.

1) The collar in my four *P. microdactylus* is virtually lacking. Some ever so slightly protruding scales might be interpreted as the outer collaria which indicate the position of the collar. The 7-9 collaria are hardly, if at all, differentiated from the preceding scales and their attachment is similar to the surrounding ones. In *P. blanci* the collar is usually attached in the middle (occasionally all 7-9 collaria are similarly attached) and composed of scales that differ only slightly from the scales that follow, and are thus often hard to discern. BOETTGER (1883) reiterated his original diagnosis of *P. microdactylus* and added [translated]: "From *A*. (*Zerzumia*) *Blanci*, its other closest relative, the Moroccan lizard can be distinguished by the form of the collar that is only distinct on the side of the neck, both entirely similar with the analogue parts in *A. Algira*." Once again this description is partly incorrect and confusing, most certainly with regards to the reference to *P. algirus*. BOULENGER (1887) was the first to be more absolute: "no trace of a collar".
2) The jugular fold is not absent in the four *P. microdactylus*, only in some specimens of *P. blanci* the fold is just a little more distinct, even though BOETTGER (1881) presented this as one of the distinguishing characters as compared to *P. blanci*, and reiterated this in BOETTGER (1883: 21) [translated]: "distinguished by the complete absence of the jugular fold".
3) A character difficult to value as the four Azilal *P. microdactylus* show granular scales but also slightly larger ones, and though most are pointed, in one specimen almost all the scales involved are more rounded. Likewise, in some *P. blanci* the granular scales are pointed, in others rounded.
4, 5) Colour seasonally dependent; these measurements were taken xii2004. Green indeed characterises *P. microdactylus* dorsally in the reproductive season (as discussed under 'Colour'). Both *P. blanci* and *P. microdactylus* may show some yellow underneath. It is my impression that only *P. blanci* can have parts of the throat coloured and that the yellow on the belly – when present – is much more intense in *P. microdactylus*, but admittedly the sample is small. BOULENGER (1889, 1891) judged *P. microdactylus* to have "lower surfaces white, outer row of ventrals lemon-yellow; throat of males bluish" (the former is correct for my wild-caught male), and in BOULENGER (1887) "lower surfaces greenish yellow". DOUMERGUE (1901), PASTEUR & BONS (1960), and BONS & GIROT (1962) correctly recognised that colour was species-specific.
6) Extremely difficult to determine in live animals, but was used in SCHLEICH et al. (1996) who evidently took the characters from BOULENGER (1887, 1921) and WERNER (1931b), as discussed in Table 3. As well, I find comparable conditions in my *P. blanci*. At most, the character states distinguish between the sexes in adult animals for, as is commonly seen in lacertids (and in other *Psammodromus*) females have a relatively longer trunk than males. Only in *Gallotia*, thought to be the sister genus of *Psammodromus* (see e.g. references in BISCHOFF, 1998), the males are considerably larger than the females.
7) LATASTE (1880) spoke of "Écailles sous-caudales très fortement carénées" when describing *P. blanci*. Strangely enough rephrased in BOULENGER (1887, 1891) for *P. microdactylus* as "Upper caudal scales more strongly keeled than the dorsals." This latter condition applies to my *P. blanci*, unconditionally to one *P. microdactylus,* to some extent to two others, but not at all to the fourth specimen.
8) A character put forward by BOULENGER (1921). These vertically elongate strongly enlarged scales in the lower eyelid are indeed absent in the four *P. microdactylus* and present in most *P. blanci* (poorly developed in one specimen).
9) Conditions mentioned in literature (e.g. BOETTGER (1881,1883); BOULENGER (1887,1891); SCHLEICH et al. (1996)) are: tubercular - sharply keeled - strong obtusely keeled - smooth, tubercular or feebly keeled. There is no difference with *P. blanci* (see also discussion of the original description). BOULENGER (1887,1891) noted more accurately for

both *P. blanci* and *P. microdactylus*: "Digits beneath with a double series of strongly but obtusely keeled scales", though the adjective 'keeled' for blunt elevations may be a matter of debate.

10) The development of head and neck was used (and partially quoted by PASTEUR & BONS (1960)) in a table by DOUMERGUE (1901: 132) with "Head and neck relatively slender" leading to *P. blanci*, and "Head and neck relatively stout" to *P. microdactylus*. However, without absolute measurements or an index, this is a character that is almost impossible to apply. Still, in direct comparison this indeed appears to be the case, and *P. hispanicus* seems more slender than the other two, but there are individual deviations.

11) According to DOUMERGUE (1901: 137) in *P. blanci* the body is 2-2½ times the distance from snout to collar, while in *P. microdactylus* the body is short and less than twice the distance from snout to collar. I measured 1.9-2.4 for *P. microdactylus* (see Table 6) and at 2.0-2.2 for *P. blanci* (see Table 2) there is no disparity between the two species but rather this index points to a morphological difference between the sexes, viz. a relatively longer trunk in female *Psammodromus* (as in many lacertids).

12) The ratio distance snout-collar / collar-anus was used (and rejected) in PASTEUR & BONS (1960: 74). Oddly enough, they exchanged the numerator and the denominator in their calculations. Using their index as given (rather than the one used in their calculations), *P. microdactylus* shows 0.42-0.59 and *P. blanci* 0.45-0.50: a clear overlap.

13) According to BOULENGER (1887, 1891, 1921) the suture between the rostral and the first labial usually falls below the anterior border of the nostril in *P. blanci*, while in *P. microdactylus* it falls below the centre of the nostril. 'Usually' is correct as it applies to three of the four *P. microdactylus* and one *P. blanci* also shows the *microdactylus*-condition. This character may hint at the identity of the forms, but has no absolute value. (A similar variation is found in *P. hispanicus*.)

14) Both *P. blanci* and *P. microdactylus* in my collection have 22-24 dorsals. Similar counts in the literature (e.g. WERNER (1931b): 23 or 24; MATEO et al. (2003): 21-24). BOULENGER (1887, 1891) counted 28 to 30 scales around the middle of the body for *P. microdactylus* (including the six ventrals), for *P. blanci* he arrived at 28-32. WERNER (1929) gave 30 dorsals, probably because, like BOULENGER (l.c.) he counted all scales around the middle of the body (incl. ventrals).

15) BOETTGER (1883) concluded that the main discerning character for *P. blanci* and *P. microdactylus* was found in the form, size and arrangement of the ventralia. This is not so. Both *P. blanci* and *P. microdactylus* have six rows of ventrals, the median and outer rows are narrower. BOULENGER (1887, 1891) previously concluded for both *P. blanci* and *P. microdactylus*: "Ventrals broader than long, the median and outer series narrower than the two others.".

16) DOUMERGUE (1901: 132) listed for *P. blanci* "première rangée des plaques de la poitrine formée par des écailles rectangulaires nettement plus longues que larges, obliques" [breast scales of the first row rectangular, clearly longer than wide, oblique], while in *P. microdactylus* the condition would be "première rangée des plaques de la poitrine formée par des écailles presque carrées, obliques, mais ne se distinguant pas nettement par leur grandeur des collaires qui les précèdent" [breast scales of the first row almost square, and oblique, but not clearly different in size from the preceding collaria]. This applies to three specimens of *P. microdactylus*, in the fourth the scales are triangular. In most *P. blanci* these scales are indeed longer than wide, but in one specimen these are almost square, a little larger than the collaria. This character thus may hint at the identity of the forms, but has no absolute value.

17) Listed by DOUMERGUE (1901: 132) for *P. blanci* "ventrales peu imbriquées, à bords droits ou à peu près" [ventrals a little imbricate, at right angles or almost so], while in *P. microdactylus* the condition would be "ventrales à bords parfois convexes" [ventrals sometimes with convex borders]. This character is open

to interpretation, but three of the four *P. microdactylus* show the attributed condition, the fourth appears more like P. *blanci*. The available *P. blanci*, however, highlight the *microdactylus*-condition too, and in one specimen the ventrals are frontally more convex, posteriorly more at right angles. Therefore, this is a fairly useless character. In fact, only the available *P. hispanicus* conform fully to the *blanci*-like status.

18) Femoral pores number 9-13 in *P. microdactylus* (BOETTGER (1881); BOULENGER (1887, 1889, 1891); WERNER (1929, 1931b)), *P. blanci* has 9-12 (BOULENGER (1887, 1921); DOUMERGUE (1901)), there being no obvious difference between the two forms.
19) The number of subdigital lamellae of the fourth toe in the four *P. microdactylus* is 15-19, comparable to e.g. BOULENGER's (1921): 15-17; WERNER's (1929): 16-17; and WERNER's (1931b): 15-18 (avg. 16-17). For *P. blanci* I recorded 16-19, and e.g. BOULENGER (1921): 17-21, usually 18-20. Again there is no disparity between the two forms.

Characters 1-5, 9, 13 and 14 were already used in the original descriptions, and reappeared in later literature in various character states and/or combinations. As discussed previously, it is only the absence of a collar (2) that differentiates *P. microdactylus* from *P. blanci*. Also, the presence of green dorsal coloration (4) can characterise *P. microdactylus* in the breeding season. It could be that only *P. blanci* sometimes has parts of the throat coloured, while the yellow on the belly in *P. microdactylus* – when present – is more intense than in *P. blanci* (5). Additionally, *P. microdactylus* lacks a central series of strongly enlarged scales in the lower eyelid (8).

When the suture between the rostral and the first labial falls below the centre of the nostril (13), this character state might point to *P. microdactylus*. Likewise, breast scales of the first row being square (16) may hint at *P. microdactylus*, as do relatively longer legs.

In the later literature, the perceived differences between *P. blanci* and *P. microdactylus* on gular fold development (1), side of the neck – axilla scales (3), hind leg stretched forward (6), upper caudal scales (7), subdigital lamellae (9), slenderness of head and neck (10), index body-length – snout-collar length (11), ratio snout-collar to collar-anus length (12), number of dorsals (14), relative size of ventrals in outer and median rows (15), imbrication and borders ventrals (17), the number of femoral pores (18), and the number of subdigital lamellae (19) are not helpful in discriminating between *P. blanci* and *P. microdactylus*.

Additionally, I measured the lengths of the front leg + toes. The length of the front legs of my *P. microdactylus* is 13-14 mm (15-16 mm in BOULENGER, 1921). The front legs of my *P. blanci* measure 11-12 mm (12-14 mm in BOULENGER, 1921). The length of the hind legs of my *P. microdactylus* is 20-22 mm (21-23 mm in BOULENGER, 1921). The hind legs of my *P. blanci* measure 17-19 mm (18-20 mm in BOULENGER (1921). Bizarrely, it is therefore *P. blanci* that has shorter legs than *P. microdactylus*, and both have shorter legs than *P. hispanicus* (front legs 12-16 mm, hind legs 19-24 mm).

Measurements taken on my sample on the toes of three species of *Psammodromus* show that the digits of *P. microdactylus* are not shorter than those of *P. blanci* or *P. hispanicus* (Table 5, Fig. 26). Each digit of the three *P. blanci*, three *P. hispanicus* and four *P. microdactylus* was tested separately with an ANOVA with head-body length as the co-variable. As this involves multiple testing (n=20), a Bonferroni correction was applied for the alpha level. Since measurements were not independent but taken from the same animal, the average correlation (r=0.4727) between digit lengths was used to calculate a partial Bonferroni correction (see http://home.clara.net/sisa/bonhlp.htm); the corrected p value is 0.0103. Only two comparisons were significant: manus left III (p=0.005) and pes left V (p=0.004). The length of manus left III of *P. microdactylus* is greater than *P. blanci*, while the length of pes left V of *P. microdactylus* is shorter than *P. hispanicus* but similar to *P. blanci*. These spurious results may easily be the consequence of the low number of animals measured so for the purposes of this study, it is concluded that all three species have similar digit lengths.

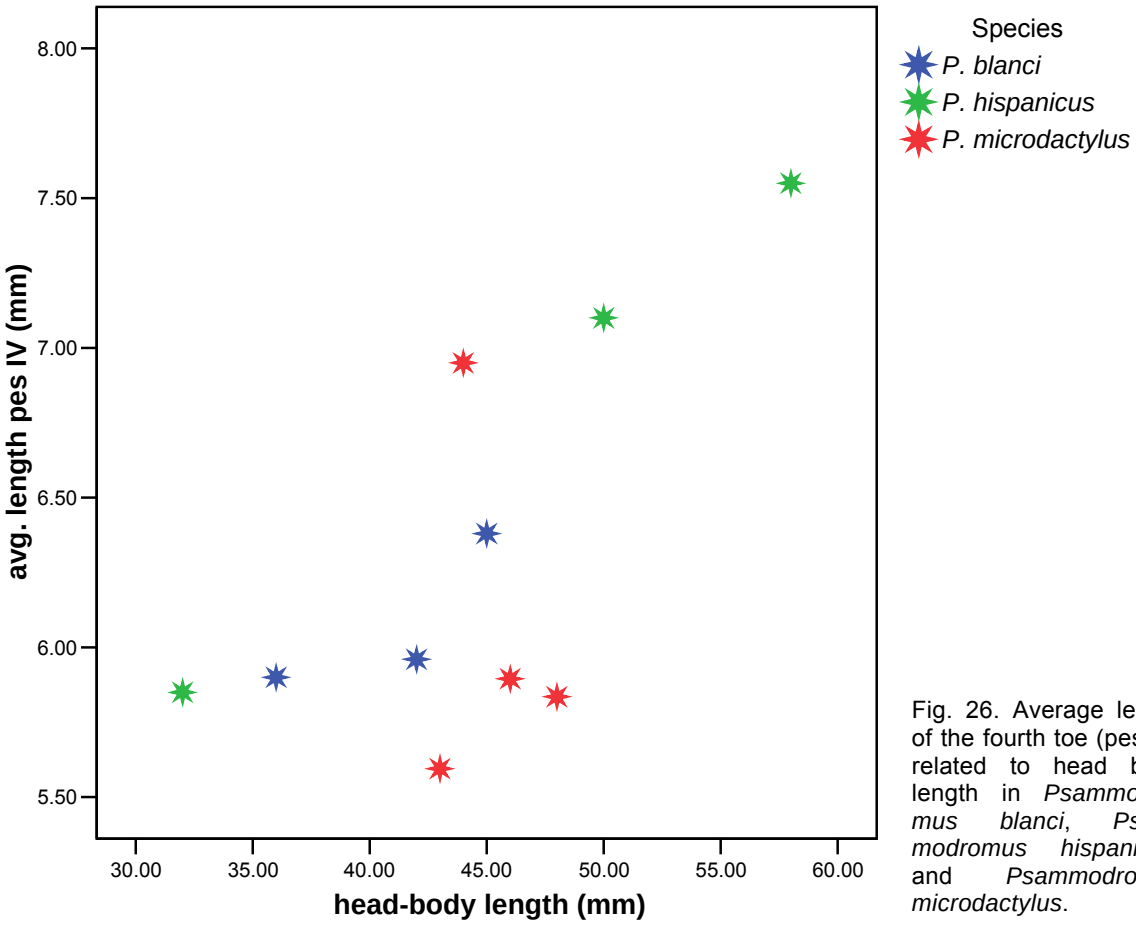


Fig. 26. Average length of the fourth toe (pes IV) related to head body length in *Psammodromus blanci*, *Psammodromus hispanicus*, and *Psammodromus microdactylus*.

Digits	*P. blanci*	*P. hispanicus*	*P. microdactylus*
manus left I	1.37± 0.12	1.32 ± 0.22	1.41± 0.05
manus left II	2.20±0.06	2.37±0.09	2.55±0.06
manus left III	3.15±0.08	3.27±0.24	3.64±0.04
manus left IV	3.23±0.05	3.37±0.24	3.68±0.11
manus left V	1.89±0.13	1.90±0.12	1.98±0.08
manus right I	1.40±0.10	1.36±0.21	1.40±0.10
manus right II	2.33±0.07	2.43±0.13	2.41±0.10
manus right III	3.17±0.09	3.30±0.25	3.42±0.05
manus right IV	3.20±0.06	3.33±0.27	3.34±0.09
manus right V	1.78±0.24	2.07±0.29	2.02±0.07
pes left I	1.68±0.02	1.80±0.15	1.65±0.14
pes left II	2.78±0.08	2.90±0.20	2.66±0.12
pes left III	3.98±0.14	4.37±0.23	4.25±0.18
pes left IV	6.09±0.08	6.80±0.51	5.87±0.40
pes left V	2.97±0.18	3.40±0.30	2.68±0.09
pes right I	1.65±0.05	1.90±0.20	1.97±0.01
pes right II	2.63±0.09	2.93±0.13	2.77±0.07
pes right III	3.98±0.14	4.37±0.23	4.29±0.18
pes right IV	6.12±0.24	6.87±0.50	6.27±0.22
pes right V	2.79±0.10	3.35±0.35	3.11±0.21

Table 5. Average length of the digits of three *Psammodromus* species (mean ± SE).

Intergrades

DOUMERGUE (1901: 138) reported an intermediate form between *P. blanci* and *P. microdactylus* from Sebdou. SCHLEICH et al. (1996) refer to a specimen from Debdou, which I believe is the same as the one mentioned in DOUMERGUE (1901) as it seems likely that Debdou = Sebdou. According to SCHLEICH et al. (1996), this specimen "showing key characters of both (PASTEUR & BONS, 1960) suggests that P. *blanci* and P. *microdactylus* could be treated as subspecies", adding however "No more intergrades were found in the last decennia". MELLADO & DAKKI (1988: 173) also mentioned intergrades in the northeast of Morocco, and that these specimens would suggest that both forms are conspecific, but did not include localities, references, or other data. A meagre foundation for further study.

Bearing in mind the broad array of features already shared by *P. blanci* and *P. microdactylus*, one marvels how an interbreed should be morphologically defined. DOUMERGUE (1901) described his specimen as having an almost completely free collar, middle ventrals being relatively smaller than the outer ones compared to Oran *P. blanci* individuals, a dorsal band with three rows of black spots, and a massive body and head as in *P. microdactylus*. As some *P. blanci* may have a stippled vertebral line (pers. obs.), the lighter stripes are often bordered by small brown spots (LATASTE, 1880), relative head and body sizes are just that, and a free collar is common in *P. blanci*, there is, apart from the ventrals being somewhat atypical (the median and outer row being normally narrower in both *P. blanci* and *P. microdactylus*), little reason to label the specimen as an intermediate.

Colour

The most obvious external characters for distinguishing *P. microdactylus* in the field are: the practically absent collar, the green dorsal coloration present in adults during the reproductive season, and the lemon-yellow outer row of ventrals seen in some male specimens (as compared to the dorsally brown and ventrally white or greenish colour seen in P. blanci). Neither the number of light lateral lines nor their degree of contrast is informative as e.g. PASTEUR & BONS (1960) and BONS & GIROT (1962) suggested (cf. Fig. 27 of *P. microdactylus* and Fig. 28 of *P. blanci*). Surprisingly, a bright green *P. microdactylus*-like dorsal coloration has been noticed in *P. hispanicus* at least once (pers. comm. David Donaire-Barroso for Cadiz, Spain, September 2003), as compared to the more commonly observed possible greenish haze in that species. Falsely, BONS & GENIEZ (1996) considered *P. microdactylus* to be the only one of the four *Psammodromus* of which the

Fig. 27. A pair of *Psammodromus microdactylus* (male left, female right).

Photo: H.A.J. in den Bosch

Fig. 28. A pair of *Psammodromus blanci* (female left, male right; beginning of mating ritual).

Photo: H.A.J. in den Bosch

adult has a vividly green coloured back. They even go so far as to propose as common name 'the green lizard' (Le Psammodrome vert, Lagartija verde).

Dorsal coloration in *P. microdactylus* is seasonally dependent. In the wild-caught female the already quite pale green dorsal band faded completely into brown at the end of May; the dorsolateral lines changed from a dull greenish-yellow into beige and brown, almost fading into the rest of the back colour. The very bright green of the wild-caught male at the beginning of April diminished in intensity much more slowly and some vague indication of green remained until the middle of July. His dorsolateral lines changed from an even brighter green than dorsally, into beige and later became almost white as can be seen in Fig. 29. Surprisingly, not one of my four *P. microdactylus* coloured green in 2005. There is no change in the ventral coloration. The throats of both sexes are white with a tinge of salmon colour. The bellies are white (young couple), in the wild-caught male the outer row of ventrals shows a brilliant yellow, in the wild-caught female the outer ventrals are yellow over approximately half their width and less intensely coloured than in the male. PASTEUR & BONS (1960) considered the bellies to be matt white with a more or less bluish hue. I do not know why DOUMERGUE (1901) thought that the tail was browner than the body, and the flanks were bluish, although the latter is reminiscent of a preservation artefact.

Evidently, there is variation in the green dorsal coloration. WERNER (1929) stated that the female is dorsally emerald green, laterally brown, without clear demarcation, without dark spots; the male has an emerald green back. Later, WERNER (1931b) wrote more elaborately on the subject:

Fig. 29. The wild-caught pair of *Psammodromus microdactylus* photographed in December. Notice the complete absence of green colour on their dorsal side.

Photo: H.A.J. in den Bosch

coloration is quite diverse: green with an olive brown dorsolateral band, which however is fairly unclear, especially posteriorly, and the tail is light brown. Alternatively, a broad dorsal zone is found in which to the sides a row of dark spots is included, bordered by a light dorsolateral line under which a lateral band with similar coloration to the dorsal region is found. The dorsal zone itself shows a median emerald green band bordered on each side by a more brownish band. The outer ventrals show a golden red or golden orangey band. WERNER (1931b) considered the plate by BOETTGER (1883) to be "very bad"; he added fine b&w photographs of preserved specimens to his paper.

The caption for the photo of a green adult male (published in both BONS & GENIEZ (1996) and GENIEZ et al. (1993)) shows it to be from 1964 (no month is indicated, but it was probably taken in early summer; the text points to BONS (1967) [not seen]). Later, in MATEO et al., (2003: 169) a picture of a young specimen was finally published, apparently taken on Oct. 3rd, 1992 that was referred to in GENIEZ et al. (1993). As was to be expected for a young animal (or an adult late in autumn) only a very faint indication of a narrow greenish-brown dorsal band can be descried.

Sizes

Maximum literature sizes for head-body in *P. microdactylus* were given by WERNER (1931b), with males reaching 45-58 mm and females 45-57 mm and total length for both ranging between 140-142 mm. My specimens reached 43-49 mm and 46-48 mm respectively, and are therefore somewhat smaller, with the exception of one male who reached a longer total length of 148 mm (Table 6). See also e.g. BOULENGER (1887, 1891, 1921) and DOUMERGUE (1901). The remarks by MATEO et al. (2003) that *P. microdactylus* have relatively short tails (less than twice head-body length) and that females grow larger than males is not really borne out by data. In fact, tail length is

about twice head-body length, the latter length being in this sample about similar in both sexes. As usual in lacertids, males have the longer tail.
It is unfortunate that a report on morphometric data of *P. blanci* and *P. microdactylus* was drafted (GALEWSKI, 2001) but never published. It may have shed light on the scattered and confusing literature remarks on the dimensions used to distinguish the two forms.

Fig. 30. A habitat of *Psammodromus microdactylus*: the earthy hill along road S310, 3 km north of El Hajeb.

Photo: H.A.J. in den Bosch

Psammodromus microdactylus	wild-caught (in 2004) male	wild-caught (in 2004) female	male born 2004	female born 2004
head-body + tail (mm)	49+99	48+85	43+92	46+80
weight (g)	3.80	3.45	3.02	3.15

Table 6. A series of measurements (in mm) on specimens of *Psammodromus microdactylus,* August 2005.

Ecology

The habitat of *P. microdactylus* consists of fairly open, relatively humid or subhumid zones, with low shrubs (commonly including the Dwarf Fan Palm *Chamaerops humilis*) plus various herbs and grass on stony, often overgrazed calcareous slopes (comprehensive remarks in Table 1). Some small-scale agricultural areas may be close by (fig. 30). WERNER (1931: fig. 4; pl. II, figs 4 and 5) published the first good habitat pictures of *P. microdactylus*, i.c. from the vicinity of Taza, showing an open landscape with a few larger trees, like *Quercus ilex*. The actual niche of *P. microdactylus* is under leaf litter and around the base of small bushes as it is a ground-dwelling lizard, not extremely agile. However – as WERNER (1931b) pointed out previously – due to the fact that it lives amongst denser, often prickly, patches of plant growth it is not easy to catch. He apparently found some specimens under stones, something other collectors did not mention. Vivarium observations do not indicate that sheltering under stones or larger objects is their favourite hiding place, instead they bury themselves in leaf litter or loose ground. Even with low temperatures in the field in March and April, we encountered lacertids as *T. pater*, *P. vaucheri*, and *T. perspicillata* under stones, but never *P. microdactylus*.
The climate of its habitat may vary from Mediterranean to montane. The species is reported from altitudes of approximately sea level (30-50 m), and from 500-2250 m. Whether or not this gap in altitudinal distribution is real, remains to be explored. MATEO et al. (2003) included altitudes of 90-2250 m but I cannot find literature data to substantiate values between 90-500 m.
With regard to annual rhythm, most observations recorded in literature (Table 1) are from early April into the end of May. A single observation at the end of June, two in early October and one in early January are known. The latter one is remarkable for the higher inland locality (altitude lacking in CROCHET et al. (2004)) with the average January temperature of nearby Fez being around 10°C and the authors reporting "a

cold wind was blowing". In the Moroccan mountains it can get as arctic as -20°C and it is therefore not surprising that observations in the Atlas Mountains are from the middle of May into June. From July-September, no observations at all are available which may suggest some form of aestivation. Similarly, the absence in November-March – apart from the single January date – may imply hibernation. Nevertheless, the seeming rarity combined with vivarium observations showing species activity throughout summer and in winter under cool but not freezing temperatures (8-15°C, with recurring possibilities to bask under lamps) indicates that given the opportunity *P. microdactylus* can be active all year round. In the Mediterranean localities this may be true in the wild, whereas in the High Atlas hibernation is obligatory.

Recorded temperatures while active are between 13-25°C, perhaps even lower – but not documented – for the one January observation. Diurnal temperature preferences thus seem to be like those given by DOUMERGUE (1901) for *P. blanci* that "shun the heat and come out in the open only in the morning and late in the afternoon". Also in captivity high temperatures (≥35°C under the spotlight) are tolerated just for a short while.

Apart from some cursory observations made just prior to preserving the lizards, no previous study was conducted on the habits of *P. microdactylus* in the field or otherwise. From the few details, it becomes clear that in the period before catching or seeing the lizards, the weather was either cold or rainy, or it was early in the day after a cool night and they basked openly. This is comparable to their behaviour in a vivarium; after the initial 10-20 minutes out in the open when the lights are switched on, they spend the rest of the time under leaves or other debris transparent to heat, either actively hunting or basking, but largely out of sight. Alternatively, field observations show that *P. microdactylus* can emerge after a hot day (Azilal on our first day) to profit from the sun during a cooler period. Further, when the animals were disturbed in a major way, they may become much more visible to the observer than they would usually be. WERNER (1931b: 304) indicated using locals to collect material (e.g. near Taza) but that the specimens were frequently too damaged to be of any scientific value. Possibly that is why six of the known *P. microdactylus* localities stem from him: residents search the areas in a brutal manner, as we found out, which in the case of *P. microdactylus* yields a catch, while the more cautious approach of the experienced herpetologists generates nothing.

One speculates on where the *P. microdactylus* stay during the undoubtedly very hot summer months in areas like the new locality in Azilal. The compacted clay offers little refuge, although cracks caused by drying out may offer additional retreat possibilities.

WERNER (1931b) noted that the species is not commonly found anywhere. This remark recurs in much of the later literature and is probably true in principal. In my opinion, this idea is to a considerable degree caused by its way of life, as the lizard spends a major part of the day in the leaf litter. Although the view now is that it occurs in small isolated populations (e.g. BONS & GENIEZ, 1996), *P. microdactylus* may in reality have more continuity in its distribution. After all, the denuded 'erme' – degraded pastures with low tufts of graze-resistant *C. humilis* – is exceedingly widespread in Morocco. One could also reflect on why an association with stands of this palm is often reported: perhaps simply because man discovers the small lacertid more easily in such despoiled surroundings with patches of bare ground? At least the menu of *P. microdactylus* does not seem to be particularly linked with the plant. On the other hand, the accumulated dead stiff and pointed leaves on their base form a perfect hiding, basking and hunting niche.

I find it quite unlikely that *P. microdactylus* has become "extremely" or even "genuinely" rare in the last century (CROCHET et al., 2004; SCHLEICH et al.1996) based as this is on the lack of new specimens and the failure to find animals in localities from which they were previously recorded. My field and vivarium observations indicate that the lizards expose themselves for only very short periods during the day. Also the fact that just two days earlier a local helper saw *P. microdactylus* more abundantly in a field about 1 km west of where we found ours, and when we visited the field with him from around 11h00-12h00 we found no indication

of the lizards at all, supports the idea that the ostensible scarcity is only due to a lack of knowledge of its behaviour. At least it seems rather improbable that the population died out within 48 hours. Moreover, we found our lizards on two consecutive days in the same small field, by looking for them at the right time. In addition, the find at Ito by Bons in 1964 (according to GENIEZ et al. (1991) and apparently published in BONS (1967)) was confirmed in 1992 (GENIEZ et al., 1993), almost thirty years later.
Some researchers report that the related *P. hispanicus* can be difficult to (re-)find. For instance, David Donaire-Barroso (pers. com.) regards the species as common in the province of Spanish Cadiz, but the maximum number of specimens he saw simultaneously was two. Further, the species may appear absent during consecutive visits and suddenly seems to be present again. My, albeit limited, experience in Portugal with *P. hispanicus* is slightly different in that I could find the species again in the same parts, but perhaps because it was early spring – when many lacertids are more noticeable – was instrumental in this. In captivity at least that species has a reasonable life-span of 3-5 years (IN DEN BOSCH, 1986b; pers. obs.), which is unlikely to cause sudden population fluctuations, such as may happen in species with a lifetime of just a single year.

Distribution

MATEO et al. (2003) cryptically stated that the species was described using specimens from Yebala. This is merely the old name of the northwestern, previously Spanish, protectorate lying west of the Rif. This is not a new locality, and the description is even less precise than the current 'between Tanger and Tetuan'. With copies of correspondence of Alfred and Henri Vaucher to Boulenger (kindly provided by David Donaire-Barroso) I tried to pinpoint that terra typica. The correspondence was dated between 5viii1886-22ii1889 and all of the letters, except for the first one, were apparently mailed from Tanger (the first one includes no indication of place). On 5viii1886, A. Vaucher asked for help in publishing a paper in a natural history journal, mentioning in passing a brother in Tanger. On 12ix1886, H. Vaucher asked for the description of the lizard Boulenger was interested in, as he has not kept one himself and cannot recall its characteristics. On 10xii1886 H. Vaucher reported sending on 3xii1886 a single specimen, which he was certain was a *P. microdactylus* and two others that might be of this form. On 9ix1887 H. Vaucher wrote that he did not dispatch any *P. microdactylus* since he only had young animals, which might be sent in the next shipment. Several *P. microdactylus* were mailed by H. Vaucher on 26iv1888. In the letter, he mentions his intention to spend three months in Tetuan where he will look for the species. The final letter of H. Vaucher of 22ii1889 declared 15 specimens of *P. microdactylus* were shipped without any indication of origins. BOULENGER (1889) spoke of 21 specimens collected by Vaucher (and two by Quedenfeldt). These letters, unfortunately, do not contain any additional information to assist in locating the terra typica more accurately.
It is unclear why BOETTGER (1883) omitted the locality 'Casablanca' from his original description (BOETTGER, 1881). WERNER (1931b: 309) thought that the later failure to rediscover *P. microdactylus* (and other species) "of the coastal region" – probably meaning Tanger-Tetuan and Casablanca, Mogador as suggested by his Karte III-5 and previously explicitly mentioned localities in WERNER (1929) – was due to "changed circumstances", this again most likely referring to his earlier statement (WERNER, 1929) on the, by then intensive, human pressure on the environment. 'Tanger' as a locality record by Pellegrin is suggested by WERNER (1929), viz. "Tanger (Pellegrin)". He then lists seven possible Pellegrin publications but includes no more information on which one is most pertinent. Four of these are not relevant in this context, leaving PELLEGRIN (1925 a, b; 1927), which I have been unable to check. It is most likely the first or the last of these three references that WERNER (1929) is referring to. The two recent finds in Cromlech de M'Soura and Forest of Sidi el Yamani (MATEO et al., 2003; CROCHET et al., 2004) indicate that in relatively undisturbed habitats the species still maintains a coastal presence.

DISCUSSION

The mix-up between *P. blanci* and *P. microdactylus* in literature is partly due to careless authors incorrectly copying data and uncritically adding new, supposedly distinguishing characters in the absence of (fresh) material of *P. microdactylus*. No doubt there is also a biological basis in that the forms truly are closely related. In the upcoming paper dealing with the reproductive data of *P. microdactylus* (In den Bosch, in prep.), this relationship will be explored further. Also, quite a number of characters that were included in the original descriptions were mainly relevant for distinguishing between the new *Psammodromus* and the, at the time, considered to be similar or related species *P. algirus*, *P. hispanicus*, *A. fitzingeri*, and *A. nigropunctatus*, and are not particularly useful to distinguish between P. *blanci* and P. *microdactylus*. Nevertheless, these features have been employed repeatedly since that time.

Thus many of the characters, or even groups of characters, used in literature to distinguish between *P. blanci* and *P. microdactylus* are not species-specific. The numerical data on scalation overlap almost completely, as do the data on sizes. Presumed morphological differences (like the subdigital scalation) do not stand up to scrutiny, or – like relative sizes, and which body parts are reached when forelegs and hindlegs are plied – show clear gender differences. Others, such as relative slenderness, are impossible to compare without exact definitions. It is shocking to discover how frequent character states, supposedly defining one species, were incorrectly attributed to the other species by subsequent authors, and that these errors were apparently never detected (see e.g. Table 3).

The similarity of *P. blanci* and *P. microdactylus* has been remarked upon frequently. DOUMERGUE (1901), and WERNER (1929) – who rated P. *microdactylus* as the western form of P. *blanci* – already noticed the slight difference between the two. BOULENGER (e.g. 1887, 1891, 1921) on the other hand, never doubted the existence of the two separate species. PASTEUR & BONS (1960) referred to the forms as the superspecies *P. blanci - P. microdactylus.* After MAYR et al. (1953) a superspecies is a grouping of very closely related and largely allopatric species. This generally means that they have common ancestry but have developed over time into true species due to their geographic isolation. Later, the term sibling species was applied by SCHLEICH et al. (1996). A sibling species is any of two or more related species that are morphologically nearly identical but are incapable of producing fertile hybrids. Both terms – defining groups just under or above species level that are inherently vague – imply that the forms do not cross successfully, an as yet untested assumption.

Although intergrades between *P. blanci* and *P. microdactylus* have been alluded to several times, only one has been described in some detail (DOUMERGUE, 1901), with just one character (middle ventrals relatively smaller than the outer ones) being peculiar. The many features shared by the two species would make such specimens almost impossible to identify absolutely based on their morphology.

From the combination of a critical evaluation of the literature, the four new *P. microdactylus* specimens, and material from the other three *Psammodromus* species, several characters can be identified to help differentiating *P. microdactylus* from *P. blanci*. These characters are green dorsal coloration in adults (especially intense in the male) in the courtship season, no or a very feebly developed collar, and a lack of a central series of strongly enlarged scales in the lower eyelid. The suture between the rostral and the first labial falling below the centre of the nostril, breast scales of the first row being square, and relatively longer legs, are character states that may hint at *P. microdactylus*.

None of my four *P. microdactylus* developed green dorsal colour in 2005, perhaps as a result of the absence of hibernation and/or a lack of ultraviolet radiation. This means that the most obvious discerning characteristic may not always be present and could – when not solely an artefact of husbandry – lead to incorrect field identification.

Several of the pholidosis characters may be ecologically correlated. Scale keeling is often an indication of a life in dense vegeta-

tion (cf. ARNOLD, 1973; 1997), preventing wear on the scales. Imbrications and overlapping in ventral scales to help avoid injury, also point to dwelling in at least partly spinose vegetated areas. The reduction of collar development may also be interpreted in an ecological context. Compared to *P. blanci*, which lives in more meadow-like surroundings (BISCHOFF & IN DEN BOSCH, 1991), but nevertheless uses prickly cushion bushes as hiding places, it was to be expected that in *P. microdactylus* – which inhabits slightly rougher terrain – the collar and gular fold are less developed and the keeling is equally developed or a little stronger.

Functionally, keeled scales with posteriorly pointed ends as in these *Psammodromus* may be a disadvantage for exploring crevices, as backing out would be quite difficult. In the same way narrow spaces under stones may pose a problem and would probably be avoided.

Considering the many features in my four adult *P. microdactylus* that seem to deviate from character states published earlier for this species, and often being quite similar to those of *P. blanci*, one might be tempted to argue that I have in reality caught the latter species or am dealing with hybrids. The fact that the new find in Azilal lies within the known distribution area for *P. microdactylus* and is about 350 km south of the southernmost documented locality of *P. blanci* in Morocco quite clearly eliminates those possibilities (cf. Fig. 3 and Fig. 31). Azilal fits nicely on the southeastern distribution border as already drawn by WERNER (1931b: Karte III-5), connecting the localities 'between Afourer and Bin el Ouidane' and 'Tadlest'.

It is premature to conclude that *P. microdactylus* faces extinction (GENIEZ et al., 1993) and even more so to deduce that this

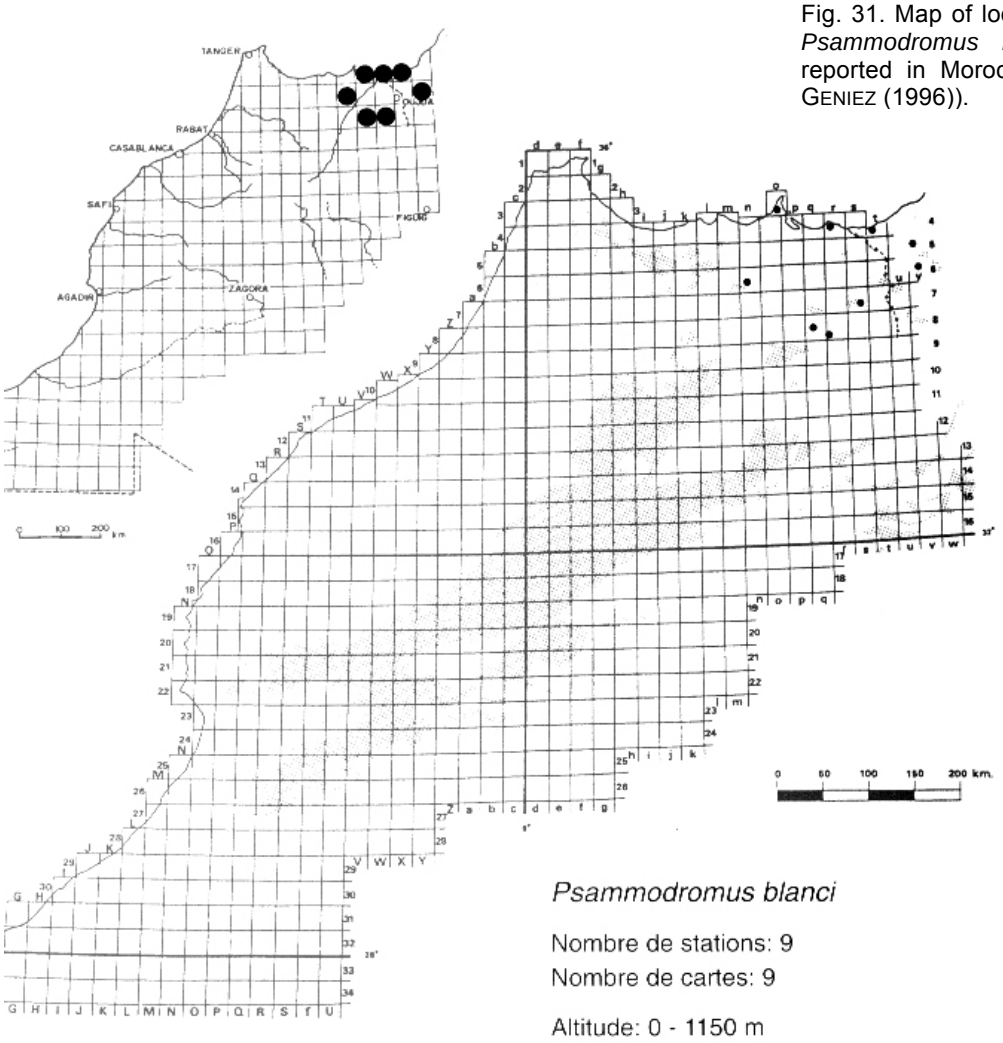


Fig. 31. Map of localities from which *Psammodromus blanci* has been reported in Morocco (from BONS & GENIEZ (1996)).

is caused by climate and habitat changes (SCHLÜTER, 2003), reiterating a modern lament. It may well be that the High Atlas vegetation in the 1930s was richer and slopes were covered in *Juniperus thurifera* and herbs like *Ptilotrichum*, *Bupleurum*, and *Astragalus* as SCHLÜTER (2003) cites on authority of WERNER (1931b) (see also analogous record in WERNER, 1931a), but note that many of the plants listed are of the spiny variety, indicative of a disturbed, overgrazed area. Besides, already half a century ago SAINT-GIRONS (1953) revealed for the High Atlas (Toubkal) "a much degraded zone of shrubbery at elevations of 500-2200 m with mutilated *Juniperus thurifera*" indicating the devastation is not recent. Habitat destruction by man is obviously a world-wide scourge, often believed to be a contemporary phenomenon, but WERNER (1929) already deplored Morocco for the built-up areas around Casablanca in the Chaouia plain. Fifty years earlier this area proved to be a rich herpetological hunting ground, as substantiated by the works of Boettger, which in Werner's time only showed the most common forms, and even those were seen only sporadically.

Ever since the more thorough collecting activities of Werner around 1930, without exception, all publications have emphasised the scarceness of *P. microdactylus*, with the most recent being CROCHET et al. (2004). However, as explained earlier, in all probability *P. microdactylus* is not an extremely rare lizard: its ostensible uncommonness is most likely due to methods of investigation and the lizard's behaviour of hunting, resting, and basking under leaf litter or even in loose soil. This behaviour is in contrast to most other Western Palearctic lizards and even its congeners (although *P. hispanicus* and especially *P. blanci* show analogous behaviour, albeit to a lesser degree). Further, the 'erme' habitat with which *P. microdactylus* has been associated by every author on the subject, which underscores its apparently very general habitat demands, is extremely common in Morocco, and leads one to expect a much larger distribution than is currently acknowledged. Moreover, the combination of the around twenty known localities, spread over a region of roughly 200x600 km with a large altitudinal range, with a broad-spectrum food choice of invertebrates, are not the expected qualities of a rare form.

ACKNOWLEDGEMENTS

Essential help in the field from my travelling companions Jeroen van der Kooij and Flip Pronk was appreciated. The translation of the Latin diagnosis was much improved upon by Hellie Klaasse, and Van Wallach (MCZ) and Ivan Ineich (MNHN) elucidated one particularly confusing aspect. Sergé Bogaerts provided photocopies of several papers. David Donaire-Barroso helped with locality names and supplied copies of Vaucher's correspondence. For advice on statistics I thank Ron Bout.

SUMMARY

Psammodromus microdactylus is reported from a new locality in Azilal, Morocco (alt. 1300 m, N 031°54:912, W 006°39:833). The presence of green dorsal coloration in adults (especially the male) in the breeding season, the absence of a collar, and lack of a central series of strongly enlarged scales in the lower eyelid differentiates *P. microdactylus* from *P. blanci*. Further, the suture between the rostral and the first labial falling below the centre of the nostril, breast scales of the first row being square, and relatively longer legs may hint at *P. microdactylus*. Many other characters used in literature proved to be derived from historical comparisons with not directly related species. An ANOVA performed on measurements on the digits of *P. blanci*, *P. hispanicus* and *P. microdactylus,* with head-body length as covariable, showed that the digits of all three species are of similar lengths. Intergrades between *P. blanci* and *P. microdactylus* have been cited several times in literature, but the many features shared by the two species make such specimens impossible to identify morphologically. The seasonally dependent adult dorsal coloration changes from bright emerald green in the male at the end of March to May into a less intense olive green to brown, with some indication of green remaining even in July. In the female, the already much paler greenish brown dorsal band of March-April fades completely into beige-brown at the end of May. The ground-dwelling *P. microdactylus*

lives predominantly under and in leaf litter and around the base of small bushes, and typically basks overtly only for short periods. This lifestyle is largely responsible for its perceived rarity. In captivity, and likely in the wild under Mediterranean conditions, it can be active all year round. The absence of any field records from elsewhere during the period of July-September and from the area of distribution between November-March, suggests periods of aestivation and hibernation respectively. As food the lizards accept a large variety of invertebrates.

SAMENVATTING

Azilal, Marokko (1300 m, N 031°54:912, W 006°39:833) wordt gemeld als nieuwe vindplaats van *Psammodromus microdactylus*. Een groene rugkleur bij de volwassenen (in het bijzonder bij het mannetje) tijdens het voortplantingsseizoen, de afwezigheid van een halskraag en het gemis van een centrale rij sterk vergrote schubjes in het onderste ooglid onderscheidt *P. microdactylus* van *P. blanci*. Als de naad tussen het rostrale schild en het eerste labiale schild onder het centrum van het neusgat valt, de eerste rij borstschubben vrijwel vierkant zijn, en de poten relatief gesproken iets langer zijn, kan dit er ook op wijzen dat we met *P. microdactylus* van doen hebben. Veel andere in de literatuur gebruikte kenmerken bleken afkomstig uit historische vergelijkingen met direct verwante soorten. Een ANOVA uitgevoerd op de vinger- en teenlengten van *P. blanci*, *P. hispanicus* en *P. microdactylus,* met de kop-romplengte als co-variabele, laat zien dat de vingers en tenen van alle drie de soorten een gelijke lengte hebben. Bastaarden tussen *P. blanci* en *P. microdactylus* zijn verschillende malen gemeld in de literatuur, maar de vele karakteristieken die beide soorten gemeen hebben, maken het onmogelijk om dergelijke exemplaren morfologisch te onderscheiden. De seizoensgebonden rugkleur van de volwassen hagedissen verandert bij het mannetje van helder smaragdgroen aan het eind van maart in een veel minder fel olijfgroen naar bruin, met nog een beetje groen zichtbaar zelfs in juli. De al vanaf het begin in maart-april veel fletsere groenbruine rugstreep van het vrouwtje verandert tegen eind mei geheel in beigebruin. De bodembewonende Groene Zandlopers leven voornamelijk onder en in het bladafval aan de voet van kleine struikjes. Typerend is dat ze slechts heel kort openlijk zonnen. Deze levenswijze is er verantwoordelijk voor dat de soort als zeldzaam te boek staat. In het terrarium, en waarschijnlijk ook in het wild onder Mediterrane omstandigheden, kan *P. microdactylus* het hele jaar door actief zijn. Het ontbreken van veldwaarnemingen elders in het verspreidingsgebied in juli-september en november-maart, doet vermoeden dat de dieren een zomer- respectievelijk een winterslaap houden. Als voedsel accepteren ze vele kleine invertebraten.

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Appendix I: List of alcohol-preserved specimens that were examined in this study

All animals enumerated here were previously used for research on courtship behaviour (permit A2013).
Algyroides fitzingeri: female born 1996, died 25ii2001 just after hibernation, loc. parents various localities Sardinia.
Algyroides nigropunctatus: male born 1982, died 5ii1988, loc. parents Yugoslavia.
Psammodromus algirus: female wild-caught 13viii1979, died 25xii1981, loc. El Barco (S. de Gredos), Spain; male wild-caught iv1979, died in hibernation 24i1981, loc. southern Spain.
Psammodromus blanci: female born 1991 (#2), died in hibernation 13i1994, loc. parents Djebel Aurès/Belezma, Algeria; female born 1990, died 7iii1993, loc. parents Djebel Aurès/Belezma, Algeria; female born 1992, died accidentally 11ii1993, loc. parents Djebel Aurès/Belezma, Algeria.
Psammodromus hispanicus: juvenile born 1984, died accidentally (drowned) 2xi1984, loc. parents Comporta, Portugal; wild-caught female, loc. Comporta, Portugal (v1982), died v1985; male born 31vii1983, died 5i1987, loc. parents Comporta, Portugal (v1982).