
ANNALS OF THE TRANSVAAL MUSEUM
ANNALE VAN DIE TRANSVAAL-MUSEUM

VOL. 30

28 FEBRUARY 1976

No. 2

THE BURROWING GECKOS OF
SOUTHERN AFRICA, 2
(REPTILIA: GEKKONIDAE)

By W. D. HAACKE

Transvaal Museum, Pretoria

(With one Plate and two Text-figures)

ABSTRACT

This study deals with the entirely terrestrial genera of southern African geckos and is published in five parts in this journal. In this part the web-footed genera *Palmatogecko* and *Kaokogecko* of the Namib Desert are discussed.

ANNOTATED TAXONOMIC ACCOUNT (Cont.)

B. Genus *PALMATOGECKO* Andersson

Palmatogecko Andersson, 1908, *Jb. nass. Ver. Naturk.* 61: 299, pl 3: la-c.
Type species: *Palmatogecko rangei* Andersson, 1908.

A slender, medium-sized, terrestrial, nocturnal gecko.

Adhesive subdigital lamellae absent. Digits joined by a web, enveloping all but two or three of terminal phalanges. Toe 5, although joined to other toes by web, opposable. Free terminal phalanges of toes and fingers bent upwards and terminating in a soft, curved nail-like tip, bearing true retractile claws on toes of females only. Phalangeal formula: manus 3,3,4,5,3, pes 3,3,4,5,4. Head flattened with pointed snout; body elongate, subcylindrical; tail unsegmented, cylindrical and tapering. Skin soft, semitransparent and covered with minute subuniform granules. Pupil vertical with slightly lobed margins, closing down to two pinholes and median slit (related to *Gekko*-type; Underwood, 1954). Extrabrillar fringe well developed. Postanal sacs present, preanal or femoral pores absent.

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Endemic to southern Africa and represented by a single species.

DISTRIBUTION: Restricted to sand accumulations of the Namib Desert from south-western Angola through the western margin of South West Africa into the Richtersveld in the Cape Province, an area with an average annual rainfall of less than approx. 125 mm (Wellington, 1955).

4. *Palmatogekko rangei* Andersson, text-fig. 1, plate 1.

Palmatogekko rangei Andersson, 1908, *Jb. nass. Ver. Naturk.* 61: 299, pl 3: la-c; FitzSimons, 1943:16, pl 5:1 and 2, pl. 12:4; Loveridge, 1947:36, pl. 1:4; Laurent, 1947:2; FitzSimons, 1950:254; Mertens, 1955:50, pl. 5:17-20; Brain, 1958:67-70, 3 figs.; Wermuth, 1965:124; Kluge, 1967:29; Mertens, 1971:43.

Palmatogekko rangei, Underwood, 1954:477.

Type locality: Lüderitz-Bucht.

DIAGNOSIS: A slender, medium sized, nocturnal, terrestrial gecko, with delicate, semi-transparent appearance, differing from all related geckos by its webbed feet.

DESCRIPTION: Body elongate, cylindrical, only slightly depressed, with thin legs, which carry body well off ground. Head subtriangular to ovi-form, with temporal area swollen; in length about $\frac{1}{4}$ of total snout-vent length; width varying from 70% to nearly 90% of head length; snout acutely pointed, in length 1,5 to 1,75 times diameter of eye and longer than distance from eye to ear. Eye large and bulging, with diameter of slightly less than distance from eye to ear, varying from 4,6 to 7,9 (N=41, $\bar{x}=7,1$) perca in adults with HB length of 50 mm and longer. Extrabrillar fringe well developed, fairly wide and flat above but changing to a prominent swelling in lachrymal area in front of eye. Pupil vertical with slightly lobed margins, which close down to two terminal pinholes and a median slit. This slit is homologous to part of *Gekko*-type (Underwood, 1954) pupil, situated between two median pinholes of closed pupil, and is formed by straight anterior edge of pupil in this part, which does not overlap lobe of posterior margin. Ear-opening small and medium sized, roundish or an oblique to vertical oval slit. Nostrils in a tubular, cone-shaped ring, consisting of a large anterior and one to three (usually two) smaller nasals, of which inner one has a semicircular part projecting into nostril. Anterior nasal separated from its fellow by enlarged internasal or postrostral scale and in some cases by a single row of smaller granules lining this scale. Rostral and upper labials separated from nasals by one or more rows of small granules, but in specimens from Mossamedes nasals may be in contact with either first labial or rostral, or both, or may be separated from both, as in normal specimens. These conditions can also occur asymmetrically. In specimen TM 25956 internasal and nasals are reduced in size and tube-like rings around nostrils are covered with fine granules. Rostral four- to six-sided, much wider but only slightly deeper than adjacent labials; upper labials 10-23; mental much larger than lower labials, lobular in shape with rounded sides and rear edge; lower labials 12-21. Posteriorly size of labials decreases to size of surrounding granules, or may disappear into the gape, for which reason often difficult to count exactly. No enlarged chinshields present. Dorsal side of head, back, chin, throat, front and part of hind limbs covered with minute, subuniform, smooth juxtaposed granules, slightly larger to

subimbricate in shape on belly and underside of hind limbs. Tail covered with fairly regular rows of squarish, subimbricate scales, larger than those on belly. On regenerated tails irregularly arranged and of unequal size. Tail unsegmented, cylindrical and tapering to a fine, slightly compressed tip, varying from 74,5 to 94,4 ($N=85$, $\bar{x}=83,9$) per cent of adult specimens, autotomising at base only. A semilunar, longitudinal row of five to eleven enlarged scales on either side of base of tail.

Limbs thin and when adpressed hindfoot usually reaches or passes just beyond elbow. Fingers joined by a slightly fleshy web enveloping all but two terminal phalanges of fingers 1, 2 and 5, and three terminal phalanges of fingers 3 and 4. Toes joined by a slightly fleshy web enveloping all but two terminal phalanges of toes 1, 2 and 5, and three terminal phalanges of toe 4, while of toe 3 the two terminal phalanges are free but third is free only on the side between toes 2 and 3. Free parts of toes and fingers bent upwards at right angles, with terminal phalange bending forward again. Dorsally webbed parts of appendages covered with similar, small granules to those of body, which become more elongate to pointed on free, distal parts of digits. Fingers tipped by a soft, curved, claw-like, elongate scale without a true claw. Toes also terminate in an elongate scale, dorsally to which a shorter, similar one occurs. In females a minute claw erupts from between these scales, while in males they appear to be fused. Underside of webbed appendages covered with flattened, subimbricate scales along anterior edges, but posteriorly scales become shortened and erect, thereby acquiring appearance of a pyramid with a hexagonal base, reminiscent of peculiar scales under feet of *Chondrodactylus* and *Kaokogecko*. Webbed parts of appendages internally reinforced by cartilaginous ribs (Part 5, Fig. 2) and sets of radially arranged muscles along ventral surface.

Sexual dimorphism: Underside of base of tail of males has two prominent, elongate, oviform swellings, into which the hemipenes are retracted. Tail base in females sometimes moderately swollen. A row of five to eleven enlarged scales on either side of base of tail, just above and behind the cloaca. In females these are flattened and relatively inconspicuous, while in males they are strongly enlarged, scallop-shaped with up-curved tips, which give this structure a comb-like appearance. According to Mertens (1955:50) they vary in size according to reproductive condition. Toes of males usually clawless (males CR 3890a and CR 3987 show claws on some toes), while females usually have clawed toes (some specimens do not show claws at all or only on some toes, but terminal scales always separated as in clawed specimens). On an average females attain a larger size than males. No sexual dichromatism has been noted.

Colour: Basic dorsal colour is fleshy-pink to pinky-brown; the rostral area and adjacent upper labials and nostrils are dark brown; a wide brown band occurs across the snout, reaching the anterior swelling of the extrabrillar fringe and extending in a thin line below the eye above the labials to above ear, where it recurves up and forward over the temporal area, reaching the eye and occasionally joining its fellow across occipital area. The parietal area is darkened by a concentration of fine brown specks; a thin brown eyebrow streak borders the extrabrillar fringe above; the supra-orbital area is bluish, due to the black eye-balls showing through

the semi-transparent skin. The back has a reticulated irregular pattern of wavy, indistinct lines or cross-bars which may give rise to a pair of dorso-lateral lines in the sacral area, in which case they are continuous with the pair of fairly regular dorso-lateral lines along tail. Pink dorsal areas of head, body, tail and extremities are powdered with fine brown specks. Chin, throat, ventral side of limbs, free tips of toes, the edge of web and underside of the tail are pink; ventrum and sides of the body are chalky-white, bordered by a yellow blotch on either side of the base of neck and behind thighs and a yellow line which extends from the armpit to the groin and has a brown dorsal edge. The extrabrillar fringe is light yellow; the iris is black with coppery to golden-bronze reticulations which form a reddish concentration above and below the pupil; the area adjoining the pupil is white.

Regenerated tails have indistinct, irregular brownish blotches or a faint pair of dorso-lateral lines above and are pink underneath. The dark dorsal pattern is very variable and although no actual colour change has yet been observed, the darkness is variable and the pattern can, especially during the night fade to such an extent that the animal becomes nearly completely flesh-coloured, but retains the white sides and underside and the beautifully coloured eyes. As the skin on the back and sides is semi-transparent the spine, ribs and some of the internal organs are visible.

Size: Largest specimen and largest female TM 42265 139,8 (77,7 + 62,1) mm, from 10km S.E. of Torra Bay. Largest male TM 32477 125,2 (67,7 + 57,5) mm, from about 50km N.W. of Ouhandjo.

ECOLOGICAL AND FIELD NOTES: A terrestrial, nocturnal inhabitant of the sandy parts of the Namib Desert, both in the true fog belt of the coast and as far as 130km inland (Koch, 1962).

Although *Palmatogecko* can be found on or near almost any dune in the Namib, it is also found on fine sand or silt of river beds, along which it sometimes reaches points surprisingly far inland, away from the coast and the dunes. In several cases populations were found to inhabit apparently isolated sand accumulations which, however, in most cases can be linked to the main range of this gecko by some present or recognizable past migratory route.

The day is spent in holes from which they emerge after sunset. Although dunes or smaller sand accumulations appear to be essential for the location of their day retreats, specimens do venture onto the surrounding plains with a harder surface. The burrows usually appear to be self-constructed, although at Sossusvlei a specimen was found occupying the same burrow as a *Ptenopus kochi* while at Spencer Bay two females shared a burrow. When unearthed and exposed to sunlight they usually attempt to dig holes for shelter. The webbed feet are ideally suited for digging and for walking on soft sand. Even the loose leeward sides of the Barchan dunes are ascended with ease. When burrowing, the sand is loosened and scooped backwards by the hand, then the foot of the same side reaches forward and pushes the sand further back. Although one limb may work at a time, first the fore and hind limbs of one side are used and may work simultaneously, alternating the fore and back strokes as when walking. When those limbs are tired the gecko changes and carries on with the limbs of the other side.

The structure of the burrow appears to be less elaborate than that of *Ptenopus*, consisting of a single unbranching passage. The opening is horizontally oval, 15 to 20mm wide and about 10mm high. According to FitzSimons (1943), who collected *Palmatogecko* near Lüderitz, the burrows are made under the lee of bushes or shelving rocks. However, Steyn (pers. comm.) found these burrows in the Walvisbaai area situated in the compact, windward sides of the barchan dunes while the author found them in the bed of the dry Kuiseb River and the stabilized sand of vegetated hummocks at Sossusvlei and Spencer Bay. Mertens (1955) found a female near Walvisbaai at a depth of 25cm, 40cm from the entrance, while the same measurements for a specimen from Vineta were 28cm and 50cm (Krieg, pers. comm.).

In the bed of the Kuiseb River near Gobabeb the burrow of a young male was about 40cm long reaching a depth of 15cm. Proctor (1928), Krieg and Kühnelt (pers. comm.) found a chamber at the end of the tunnel, in which its occupants spent the day lying with their heads facing the entrance. Although the tip of the tail is very thin and mobile and can curl around a supporting object, it is not prehensile in the true sense and it is not clear to what extent it could hold on if dragged from its burrow by a predator as suggested by Proctor (1928).

Considering its harsh environment, the delicate appearance of this gecko is even more impressive and it is clear that its adaptations to these conditions must be extremely successful. As the geckos do not possess a pineal eye, which acts as a thermo-regulator in other lizards, this group poses a special problem and it is suggested by Steyn (1962) that the semi-transparent skin of geckos, such as *Palmatogecko*, might play a role, as they still have an epiphysis which is the actual pineal organ. By behavioural adaptations, i.e. becoming nocturnal and sheltering in a burrow with a more suitable microclimate, they escape the dry heat of the day. Brain (1962) carried out some experiments to establish the critical maximum temperature for some nocturnal as well as diurnal reptiles in the Namib Desert. The mean for *Palmatogecko* was 43,5°C, which is surprisingly high for such a delicate lizard and it is very close to the 43,9°C of the diurnal gecko *Rhoptropus afer* from the same area. By recording the temperatures when panting started, a marked physiological difference was illustrated as the mean was 36,2°C and 42,0°C for the two above-mentioned species respectively, illustrating the lower heat tolerance of the nocturnal animal. Further observations by Brain showed that the active temperature-range for *R. afer* varied from 28,5–36,5°C in contrast to the range of 10,2–20,0°C of the nocturnal geckos *Ptenopus garrulus* and *P. carpi*. During October 1966 five specimens of *Palmatogecko* were found to be active at temperatures varying from 14,8–24,2°C which, although not conclusive, indicates a range similar to that observed for *Ptenopus*. Along the coast heavy fogs are frequent and may reach points up to 50km and further inland. Beyond that zone the nightly drop in temperature results in a correlated steep increase in relative humidity with a heavy precipitation of dew. In an unpublished report on the longevity of *Palmatogecko* in captivity, Professor W. Kühnelt, from Vienna University, describes it as a typical "Feuchtlufttier (moist-air animal)" although this species occurs in a severe desert. He came to this

conclusion on the basis of observations made on captive specimens, as they only continued their normal activities in an atmosphere with a relative humidity near saturation point. Dew is licked off rocks, pebbles and plants, but water from pools is ignored (Proctor, 1928). The nights in the Namib are usually very calm, which is essential for the precipitation of dew. Occasionally, during parts of the night, a strong wind may blow. *Palmatogecko* was observed under these conditions in the Munutum River, north-east of Cape Fria. The temperature at about 22h00 was down to 14°C and a strong south-west wind, typical for that area, was blowing and was driving the sand in sheets over the windward sides of the low barchan dunes. *Palmatogecko* was found on these parts of the dunes, lying flat on their bellies, and reluctant to move, exposed to flying sand. When moving they crawled forward on their bellies, apparently thereby avoiding being blown away. To account for their exposure to these conditions it was assumed that they were on the lookout for food. Surprisingly, fishmoths were observed running around on the sand, apparently completely unaffected by the prevailing conditions. On the sand surface the effect of the wind and the driving sand appeared greatly reduced and lepidoptera obviously benefitted from this and their flat, convex contours. However, the stomach contents of these geckos revealed no lepidoptera remains, so that their voluntary exposure has still not been explained.

An interesting problem, which has not yet been investigated, concerns the behaviour of *Palmatogecko* during "east-wind" weather which occurs in the Namib during the winter months. The hot "bergwind" causes night temperatures of 16° to 27°C while the relative humidity only reaches 40 to 50% which is far below the normal (Logan, 1960:20). Observations by Krieg (pers. comm.) indicate that this gecko does not leave its burrow in these conditions.

The food consists of a great variety of small arthropods and their larva or nymphs and the following were found in the stomachs of specimens from different localities: termites, curculionid and tenebrionid beetles, tenebrionid larvae, acridids, gryllids, gryllacrids, hexysopid solifugae, a mygalomorph spider, pieces of grass and other unidentifiable material. A small amount of sand was often mixed with the food, while many specimens were infested with nematodes. In captivity mealworms, young crickets, beetles and grubs as opposed to winged insects (Proctor, 1928), flies, small butterflies, worms (Werner, 1915) and termites have been taken; Krieg (pers. comm.) observed *Palmatogecko* eating ants.

Little is known concerning the reproduction of this gecko. Two eggs develop at a time, but may be laid individually. They are hard-shelled and extremely fragile and, as the surface is sticky, they become encrusted with sand (Plate 1). Two batches of eggs in the State Museum, Windhoek, CR 3998 from 48km south-west of Orupembe and CR 4041 without locality data, were collected respectively on 18 November and 18 December 1966. The measurements of the one intact egg of the latter batch are $21,2 \times 10,0$ mm. The only case of mating which has been observed took place during December at Gobabeb (Koch, pers. comm.) and was photographed by Ross (1972:9). However, the photograph indicates that two males are involved. The high incidence of bite marks on specimens and the abovementioned homosexual encounter suggest that sex recog-

nition is on a trial and error basis and successful mating depends on the collaboration of a female in a suitable physiological condition. Egg development can be observed through the transparent dorsal skin. Of 11 females examined on 11 January 1974 at Spencer Bay two were immature subadults, two were non gravid adults which might have laid already, while the remaining seven were gravid of which one had very small, still undeveloped ova. Females from Gobabeb, Swakopmund and Rooibank laid eggs on 7, 21 and 28 January respectively. The specimen from Swakopmund had been in captivity for three weeks before laying. Two females from 14km S.E. of Rosh Pinah showed developing eggs until the beginning of March, but ejected them before full term. From the batch laid on 21 January a juvenile (TM 42903), measuring 33,8 (20,0 + 13,8)mm, hatched on the 23 April. Other juvenile specimens with HB measurements of less than 35mm were collected at various localities in the central Namib during May, June and August. From the available data it thus appears that the eggs take about three months to hatch and are laid from November until about May.

Palmatogecko has not been observed to produce any sounds except when agitated or in distress. The threat attitude has been well described and illustrated by Werner (1915) and Brain (1958). The gecko raises itself high on its legs by straightening them. The throat is inflated, the body slightly arched and strongly laterally compressed, thereby accentuating the yellow lateral stripe, which is present in some populations. Raising its arched tail, it sways from side to side and starts hissing. If the cause of the agitation is not removed, and especially if the specimen should be touched, the performance may culminate in a faint squeak, as the gecko lunges and snaps at the intruder in a rather jerky manner. This behaviour is evoked in specimens in good condition by the approach of another individual and is certainly most suitable as an intraspecific warning system. However, it is also performed when molested by a human or even when suddenly sprayed with water. In the latter case the gecko will jump about in its jerky way, squeaking and snapping at the cause of the agitation.

Although the tail of *Palmatogecko* will break off and regenerate, it does so less readily than, for example, that of the arboreal genus *Hemidactylus*. Brain (1958) found, in samples available to him, that 19% of the former, against 40% of the latter genus, had regenerated tails. A similar ratio was found in nature at Spencer Bay where out of 24 specimens examined only four *Palmatogecko* had regenerated tails. In the present study of 294 preserved specimens 79,6% still had their original tails, of 10,5% the tails were regenerated from the base while the remaining 9,9% had their tails broken at the base and lost. This proves that autotomy is confined to the base only.

The skin is shed in pieces (photo by Brain in Hills, 1966) and is eaten, a process which has been discussed for a variety of lizards by Bustard and Maderson (1965).

The distribution is strictly linked with a sandy habitat throughout the Namib Desert, from south of the Orange River to Mossamedes in Angola and inland up to 160km from the coast (Koch, 1962:75). The altitude of the greater part of this area is less than 750m. It is an area with

ultra-desertic features (Koch, 1962), with an average annual rainfall of less than \pm 125mm (5 inches) according to Wellington (1955); Zelle (1956/7) indicates even less than 50mm (\pm 2 inches) for the same area. Precipitation is usually caused by sporadic thunderstorms and no rain may fall in places for several years.

The factors determining the southern limit of its range are not clear at present. The most southern record is from red, vegetated dunes at Daberas in the Holgat River valley on the coastal plains of the Richtersveld in the north-western Cape Province. Sandy conditions continue southwards all along the coast practically to the Cape. Approximately 8km N.E. of Port Nolloth accumulations of bare sand dunes occur, a habitat which normally further north in the Namib is unknown to be without *Palmatogecko*.

However, another nocturnal, terrestrial, psammophile gecko, *Pachydactylus austeni* Hewitt, occurs there with its range extending southwards to the western Cape coast. Its ecology appears to be so similar to that of *Palmatogecko* that, although it has no obvious morphological adaptations to this biotope, it seems competitive enough that these species mutually exclude one another from an area, thereby limiting their range extension in either direction in a contact zone situated in the area between Port Nolloth and Daberas (Fig. 1).

South of the Orange River, at Bloeddrif and Sendelingsdrif, specimens were collected on windblown sand accumulations on rocky hillsides. The lower Orange River constitutes no effective barrier as it stops running at times and is then readily crossed by psammophilous animals. North of the Orange, as far as the Koichab, the area consists of more or less isolated dunes, dunefields, rock outcrops and gravel plains. Between the Koichab and the Kuiseb Rivers lies the greatest accumulation of sand in the Namib, in the form of a continuous sand sea, containing some of the highest dunes in the world and extending as far as 130 km inland. The dunes are continuous, with few interruptions by isolated mountains, rocky outcrops, interdune sandy plains and salt pans, which are formed where rivers from the escarpment have been dammed by shifting dunes. This part of the Namib probably maintains the major part of the total population of *Palmatogecko*, as it is known from the coast and was observed by Koch (1962) on the dunes near farm Arib, about 130km inland. The Kuiseb River is an important faunistic boundary, which divides the Namib into northern and southern parts as is clearly shown in the distribution of the Tenebrionidae (Koch, 1962). At Gobabeb *Palmatogecko* has been observed to cross the Kuiseb onto the southern edge of the gravel plains. It is still unknown how far inland *Palmatogecko* occurs along this river. Judging from Koch's observations near Arib, it is fairly certain that it occurs at least as far as the river is skirted by dunes along its south bank and probably a little further. The Swakop River is reached along the coastal belt of dunes, which crosses the Kuiseb at its mouth. To what extent the Tubas River, which ends behind these dunes, is inhabited by this gecko, has not yet been investigated. The Swakop is well populated and specimens have been collected along its course as far as Riet, which is about 100 km from the coast. The records from Husab and Pforte are from populations occurring on fairly coarse sand accumulations of about

1 hectare in area, overgrown with *Arthrurus leubnitziae* bushes. Although these localities are isolated, with the Husab locality about 3km north of the Swakop and the Pforte locality another 15km further north, they are linked by a dry, shallow tributary of the Swakop, which might have had a better cover of silt in the past. It can be assumed that the Kahn River, a tributary of the Swakop, at least in its lower course, is also populated in suitable spots. North of the Swakop the coastal plain is rather flat and featureless and the next true dunefields occur only about 15km south of the Unjab River mouth, about 300km north of the Swakop (Current maps indicate a non-existent dunefield just north of the Huab River, but a speedometer check proved the first continuous dunes to start 80km further, about 15km south of the most southern arm of the Unjab delta). Although no barchans occur in this area, sand accumulations occur all along the coast and small dunes build up on the lee side of bushes and other obstacles. This appears to be sufficient to maintain the continuity of the population, as specimens have been recorded from various localities along the coast and even inland as far as the Rössing Mountains. The northern dunefields, although interrupted in places, are faunistically continuous and reach the Coroca River near Port Alexander in Angola, but *Palmatogecko* occurs as far north as Mossamedes, which is regarded as the northern limit of the Namib. As *Palmatogecko* has been collected in five of the ten major rivers in the northern Namib, all the dry river beds can be considered as possible migration routes inland across the gravel plains. The occurrence of this gecko on farm Vrede, near the Bethanis waterhole, can possibly be attributed to a connection with a small tributary of the Huab River. It is possible that *Palmatogecko* can traverse gravel plains by either moving from one accumulation of sand to the next in the lee of bushes or by moving along with loose barchan dunes. The first method is faster while the second might take several generations to cover a limited distance.

A number of snakes sharing the habitat of *Palmatogecko* prey on it. Of these *Bitis peringueyi*, the Namib Sidewinder, must be regarded the most important as it occurs on dunes from near Lüderitz to just north of the Kunene River. From Lüderitz to south of the Orange River *B. schneideri* could be the main predator on sand. The horned adders *B. caudalis* and to a lesser extent the rarer *B. cornuta* prey on this gecko wherever it leaves the high dunes and ventures onto the surrounding plains or into the river beds. In captivity the Namib Golden Mole *Eremitalpa granti namibensis* devoured *Palmatogecko* with great enthusiasm and must therefore be considered as a predator of some importance where it occurs. Although *Palmatogecko* is usually free of external parasites two specimens from Brandkaross (TM 22654 and 22655) are infested with mites. However, it is possible that these geckos were kept alive in captivity, where they were infected.

RANGE: The sandy parts of the Namib Desert from south-western Angola through South West Africa to the Richtersveld in the north-western Cape Province.

RECORDED LOCALITIES (Gazetteer in Part 1): Arib (TN); Awasisb (TN, SW); Bloeddrijf, Brandkaross (TN); Bundfeldschuh (M, L); Cape Fria (TN); 33km E. of Cape Fria (SW); Charlottental (K); Conception Bay (S); Daberas Dunes, Daberas in Holgat River, Foz de Cunene (TN);

Goanikontes (M); Gobabeb (TN, SW); Hentiesbaai (MS,SW); Hoarusib River Mouth (SW); Husab, Koichab Pan (TN); Kolmanskop (L); Lacrau (TN); Lüderitz (F, M, L, A, S, TO); Mile 66 N. of Swakopmund (TN); Mile 110 N. of Swakopmund (SW); Mossamedes (TN); in Munutum River 42km N.E. of Cape Fria, north-western dune fields in square 1711 Db (TN, SW); Obib Dunes (TN); Okotusu Area (TN, SW); Omaruru River 17km from mouth (SW); Oranjemund (TO); 50km S.W. of Orupembe (SW); 50km N.W. of Ouhandjo (TN, SW); Palmenhorst (TN); Pforte (F,L,A,TN); Pomona (M,TN); Porto Alexandre (TN); Prince of Wales Bay (F,M,L); Riet (TN); Rio Coroca Mouth, Rocky Point (TN); Rooibank (M,TO,TN,SW); 14km S.E. of Rosh Pinah (TN); Rössing Mountain (TN,MI); Saddle Hill (SW); Sandwich Harbour (TN); Sarusas, 17km N.W. of Sarusas West (SW); Schirielatz (TN); E. of dunes in Sechomib River (SW); Sendelingsdrif (TN); Sossusvlei, in Tsauchab River 27km E. of Sossusvlei (TN, SW); Sylvia Hill, 12km S.E. of Sylvia Hill, 10km S.E. of Torra Bay, Tsauchab River 40 km W. of Sesriem, Tsondabvlei (TN); Unjab River Mouth (TN, SW); Farm Vrede nr. Bethanis Waterhole (SW); Farm Waaihoek (TN); Walvisbaai (M, TN); 17km N. of Walvisbaai (TN); Wlotzkas Baken (M); 8 km S. of Wortel (TN).

Without substantiating evidence the record from Helmeringhausen (Mertens, 1971:43, SMF 65975) is unacceptable since it is so far removed from the known range and preferred habitat.

MATERIAL EXAMINED: Three hundred and fifty one specimens.

TRANSVAAL MUSEUM: TM 15352, 15384, 15625-8 Lüderitz; TM 20748-55, 20757-60, 20762-7, 26021, 26833-4, 32038-9 Rooibank; TM 20833, 20904, 20961 Oranjemund; TM 22265-9, 22654-5, 22684-5, 22687-9, 25149, 25194, 26457-60, 35255 Brandkaross; TM 22558-63, 22567-8, 22571, 23968 Porto Alexandre; TM 22656 Daberas Dune; TM 22823-33, 22835, 24008-11 Mossamedes; TM 23954 Mile 66; TM 23965-7 17 km N. of Walvisbaai; TM 24004 Arib; TM 22977-81, 34191-4 Sendelingsdrif; TM 24937-8, 24940-3, 24956-7, 27201 Walvisbaai; TM 25038-40, 25111-6, 25892, 25948-51, 25953, 25955-8, 25960-2, 26015, 28427, 31183, 31366, 32335, 32337, 34420-1, 39447 Gobabeb; TM 21933-6, 32663, 34890 Swakopmund; TM 25952, 25954, 25959 Sandwich Harbour; TM 27732-4, 27783-4, 28072 Obib Dunes; TM 27807, 35263-4 Bloeddrif; TM 31399-402 Unjab River 8km from mouth; TM 31462 Rocky Point; TM 31532-4 Munutum River 42km E. of Cape Fria; TM 31644-6, 36996-9 Tsauchab River 40km W. of Sesriem; TM 31647-50, 37013, 37322 Sossusvlei; TM 31731-42 Palmenhorst; TM 32043-9 8km S. of Wortel; TM 32064-6 nr Pforte; TM 32084-90 Husab; TM 32311-24 Riet; TM 32437, 32447-50 Okotusu area; TM 32476-81 50km N.W. Ouhandjo; TM 32520-1 north-western dune field in square 1711 Db; TM 32664 Schirielatz; TM 34195, 34541 Daberas in Holgat River; TM 36377 Rössing Mountain, TM 36922-26, 36939 Tsondabvlei; TM 37073-4 12km S.E. of Sylvia Hill; TM 37075 Sylvia Hill; TM 37100 Awasib; TM 37138-40 Koichab Pan; TM 39067-73 Cape Fria; TM 40398 Mouth of Rio Coroca; TM 40663, 40707 Foz de Cunene; TM 40700-3 Lacrau; TM 42264-8 10km S.E. of Torra Bay; TM 42356-7 14km S.E. of Rosh Pinah; TM 43916 Waaihoek.

STATE MUSEUM: C 898, CR 2080a+b, 3890 (3), 3986a+b Sossusvlei; CR 1960b, 2451a+b, 2531, 2639 a-c, 2732a+b, 3095-8 Rooibank; CR 1960a, 2071a-c, 2071a+b, 2092a+b, 2145a+b, 2674a-d, 2733, 3805a-c Gobabeb; CR 2866a+b, 3387 Unjab River Mouth; CR 2945, 3750a-i, 3810a+b Hoarusib River Mouth; CR 3652 Mile 110 N. of Swakopmund; CR 3824a+b Unjab River 8km from mouth; CR 3881a-c Munutum River 42km W. of Cape Fria; CR 3916a-c Farm Vrede; CR 39 5 Khumib River 17km E. of Sarusas West; CR 3965a+b Tsauchab River 40km W. of Sesriem; CR 3987a-d, 4108a-d Saddle Hill; CR 4003a-d, 4004a-d Sechomib River E. of dunes; CR 4042, 4486 Hentiesbaai; CR 4043a+b Omaruru River 17km from mouth; CR 4520, 4534-5, 4536a+b Okutusu area; CR 4543a (2), 4543b (2) 50km N.W. of Ouhandjo; CR 4570-1 N.W. dunefield in square 1711 Db; CR 4689 nr. Awasib.

C. Genus *KAOKOGECKO* Steyn & Haacke

Kaokogecko Steyn & Haacke, 1966, *Cimbebasia* 18: 6, 9 figs., 7 pls.

Type species: *Kaokogecko vanzyli* Steyn & Haacke, 1966.

A slender, medium sized, terrestrial, nocturnal gecko.

All fingers and toes with two terminal, transverse, adhesive lamellae, of which the distal one is subdivided into two halves. Toes clawed in both sexes; in general no claws on fingers. Fingers slightly webbed at base, toes 1-4 enveloped by a web up to second or third terminal joint while toe 5 is free. Strongly enlarged, transverse, wedge-shaped, callous scales occur under fingers 2 to 4, but are poorly developed under finger 5 and practically absent under pollex, absent under toes. Phalangeal formula: manus 3,3,4,5,3, pes 3,3,4,5,4. Head flattened with pointed snout; body elongate, subcylindrical; tail unsegmented, cylindrical, tapering. Skin soft, semitransparent and covered with minute subuniform granules above, but small, flattened subimbricate scales ventrally. Palms of front and hind feet covered with subhexagonal scales with a median point, similar to those in *Chondrodactylus*. Pupil vertical with lobed margins, closing down to four pinholes (*Gekko*-type; Underwood, 1954). Extra-brillar fringe well developed above and in front of eye. Postanal sacs present, pre-anal or femoral pores absent.

Endemic to southern Africa and represented by a single species.

DISTRIBUTION: Restricted to the northern Namib Desert, in an area with an average annual rainfall of less than approximately 125 mm (Wellington, 1955).

5. *Kaokogecko vanzyli* Steyn & Haacke, text-fig. 2.

Kaokogecko vanzyli Steyn & Haacke, 1966, *Cimbebasia* 18: 6, 9 figs., 7 pls; Mertens 1971:36.

Type locality: About 29 km S.W. of Orupembe, Kaokoveld, South West Africa, $\pm 18^{\circ}18'S$, $12^{\circ}17'E$., altitude 1800 feet.

DIAGNOSIS: A slender, medium sized, nocturnal, terrestrial gecko, superficially resembling both *Palmatogecko rangei* and *Colopus wahlbergi*, but differing from both in combining the presence of adhesive lamellae under all digits with a web joining toes 1 to 4 of the hind feet.

DESCRIPTION: To the detailed original description may be added that the average eye diameter equals 6,9 percra ($N = 32$, range 6,1–7,8). The average tail length of adults equals 70,5 percra ($N = 26$, range 59,4–78,7). Tail autotomy is largely restricted to the base of the tail. Of 61 specimens examined 82% still had original tails, 13,1% had the tail regenerated from the base while 3,3% had their tails broken and lost at the base. A single specimen (1,6%) had part of the tail regenerated forming a bifurcate tip.

Sexual dimorphism: Underside of tail base in males has two prominent, elongate oviform swellings, into which hemipenes are retracted. The absence thereof in females makes the sexes easy to distinguish. On either side of tail base, just above vent, is a longitudinal row of three to five scales. In males these are quite prominent and upward-curving and situated on the above mentioned swelling, while in females they are flattened and much less developed. No sexual dichromatism was observed.

Colour: Basic dorsal colour is light brown, the parietal area and sides of the head, the sides and underside of the limbs and a row of four to seven blotches, which may be more or less confluent to form a vertebral line, and about five blotches on original tails, being purplish to brownish pink. The blotches on the back and tail are bordered by more or less confluent rows of dark brown to black specks. A brown median line consisting of specks runs back from between the eyes to the occipital region, where it splits into two branches, each of which curves over the temporal area to reach forward to just behind the eye. Similar specks are irregularly scattered in the brown area of the abck, head, neck, body, limbs and tail in specimens from the type locality and the adjacent southern localities while in specimens from N.W. of Ouhandjo and the Okotusu area the black and brown is largely restricted to the border of the vertebral and caudal blotches. The snout is brownish and the supraorbital area bluish, due to the black eyeballs showing through the semi-transparent skin; extrabrillar fringes are light yellow above and in front the eye, but white below and behind; the belly and underside of the tail white, and a number of white spots occur on the sides of the body, on the limbs and feet. Regenerated tails are irregularly speckled above but white underneath.

The colour varies only slightly amongst specimens of a series from one locality but markedly amongst specimens from different sites. Preserved specimens lose the pinkish colours and turn whitish with only the dark-brown markings remaining.

Size: Largest complete specimen CR 4000/10 (Paratype, female) 109,1 (63,7 + 45,4)mm. Largest specimen and largest female CR 4000/4 (Paratype) HB = 65,5mm, tail regenerated. Both from type locality about 30 km S.W. of Orupembe.

Largest male TM 32485 99,5 (60,0 + 39,5)mm, from about 50km N.W. of Ouhandjo, Kaokoveld.

ECOLOGICAL AND FIELD NOTES: A terrestrial, nocturnal inhabitant of the gravel plains of the northern Namib Desert which are in places overlain by belts of loose barchan dunes or are interrupted by rocky outcrops, especially in the vicinity of the dry rivercourses. Although the undulating plains are preferred, rocky outcrops with sand accumulations are ascended

and specimens may be found sitting on rocks. No specimens have been collected yet on a barchan dune.

The day is spent in a hole from which they emerge shortly after sunset. From collecting records it appears that the population activity is at its peak within the first hour after dark, after which time fewer specimens are seen although some have been found still active around midnight and others have actually been collected on the surface just before sunrise.

Digging takes place in similar fashion to that of the other burrowing geckos insofar as the excavation is done with a forelimb and the debris is pushed back with the hindlimb of the same side until after a while the limbs of the other side are used. However, *Kaokogecko* sometimes actually clasps and picks up some of the debris with its hindfoot and deposits it further back instead of just pushing it backwards. While excavating, the terminal two joints of fingers 1 to 3 and 5 and the terminal three joints of finger 4 are raised off the ground so that the enlarged wedge-shaped scales under the finger do the actual loosening of the soil. Thereby the very delicate adhesive lamellae are kept out of the way of injury.

The entrance to their burrows has a similar appearance to that of *Palmatogecko*. It is horizontally oval and about 15 to 20 mm wide. During the day the entrance sometimes becomes blocked either voluntarily by its inhabitant, or by crumbling sand. The structure of the burrows has not been studied closely but specimens have been unearthed at a depth of 15 to 20cm below the surface.

Although specimens of *Kaokogecko* and *Palmatogecko* may be collected next to one another on the gravel plains near dunes, there appears to be a distinct habitat preference when selecting the sites for their burrows, as was observed at the locality east of Sarusas West. There *Kaokogecko* and *Palmatogecko* emerged from burrows a few yards distant, but the former's was in the gritty sand while the latter's hole was in a sand accumulation against the slope of a hill.

At present it appears that *Kaokogecko* occurs mainly to the east of the coastal dunefields, an area with an altitude of below 600 metres above sea level and not closer to the coast than about 15km. Another terrestrial nocturnal gecko in association with *Kaokogecko* is *Pachydactylus punctatus*, while *Ptenopus carpi* and *Chondrodactylus* occur in the southern part of its range and *Palmatogecko*, in the vicinity of dunes. The Horned Adder *Bitis caudalis* must be considered as the main predator but *Pythonodipsas carinata*, the Western Keeled Snake, is a possible predator where *Kaokogecko* ascends rocky outcrops.

The stomach contents of several specimens consisted of the remains of small insects such as termites, small beetles and others. Intestinal parasitic worms occur while mites are found as external parasites.

RANGE: Northern Namib from the Sechomib River into south-western Angola (Fig. 2).

RECORDED LOCALITIES (Gazetteer in Part 1): Espinheira (UM); Kakolo Windmill (TN); 15km S. of Kunene River N.E. of Okotusu (SW); N.W. dunefields south of Okotusu in square 1711 Db, about 30km S.W. of Orupembe, localities given as about 50km inland from Cape Fria on track to Orupembe, 55km E.S.E. (not S.S.E.) of Cape Fria and 58km S.W. of Orupembe are all in close proximity to one another and fall

within the same grid square (SW, TN); about 17km E. of Sarusas West on east side of the Khumib River where the track to Sesfontein crosses this river (SW); 50km N.W. of Ouhandjo; Sanitatas (M1); Sechomib River 30km S.W. of Orupembe (TN).

MATERIAL EXAMINED: Eighty-eight specimens.

TRANSVAAL MUSEUM: TM 32376-85, 32519, 32802-17, 32821-4 about 30km S.W. of Orupembe; TM 32482-6, 32818-20 about 50km N.W. of Ouhandjo; TM 32554-5, 32825 about 58km S.W. of Orupembe; TM 32518 N.W. dunefields in square 1711 Db; TM 39022-33 Sechomib River 30km S.W. of Orupembe; TM 40711-17 Kakolo Windmill.

STATE MUSEUM: CR 4000/2, 4, 5, 7-9, 11, 15-17, 4046/1-5 about 30km S.W. of Orupembe; CR 4064/1-5 about 55km E.S.E. of Cape Fria; CR 4064/2-4 eastern bank of Khumib River 17km upstream from Sarusas West.

UMTALI MUSEUM: UM 27437-8 Espinheira.

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SUIDELIKE AFRIKA

SOUTHERN AFRICA

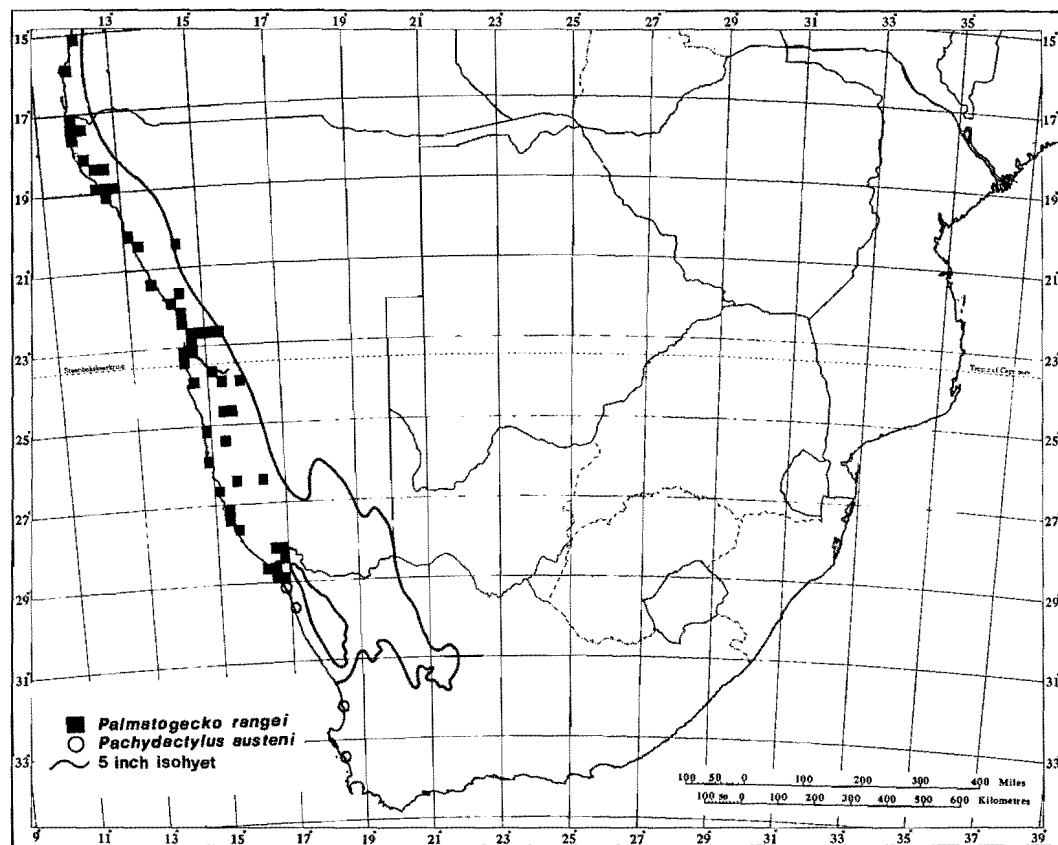


Fig. 1. Distribution of *Palmatogeco rangei* and *Pachydactylus austeni*.

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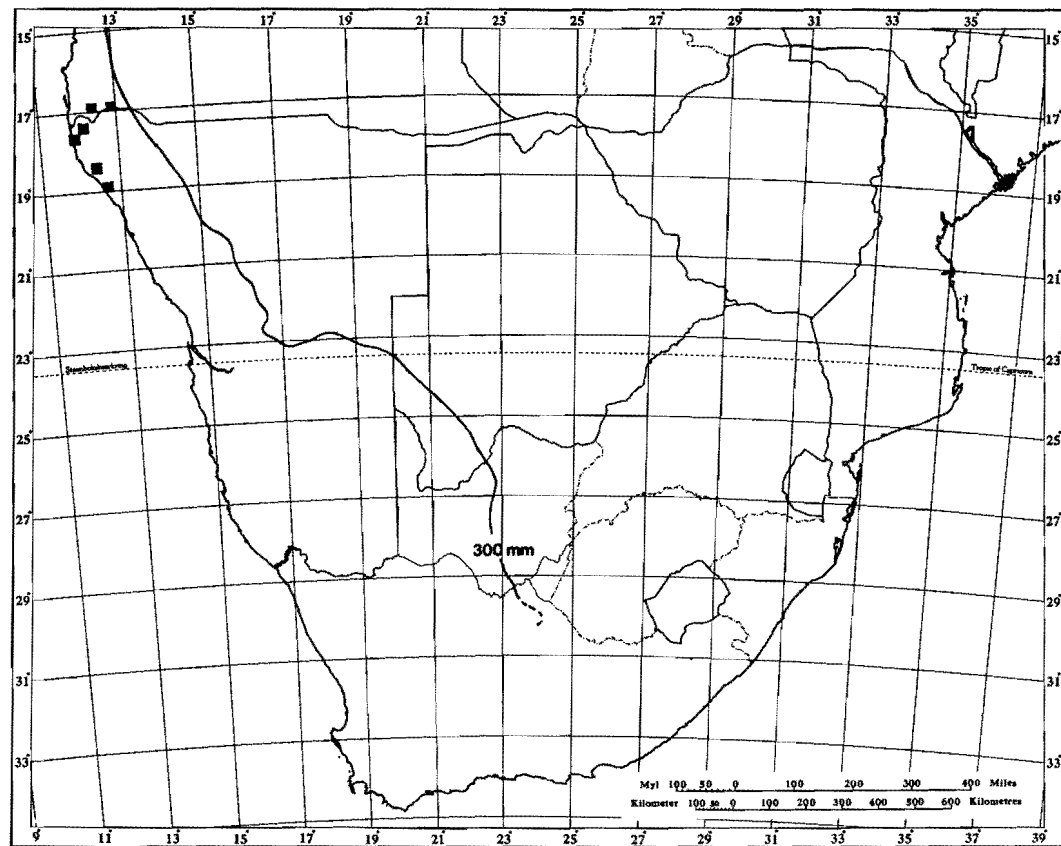


Fig. 2. Distribution of *Kaokogetko vanzyli*.

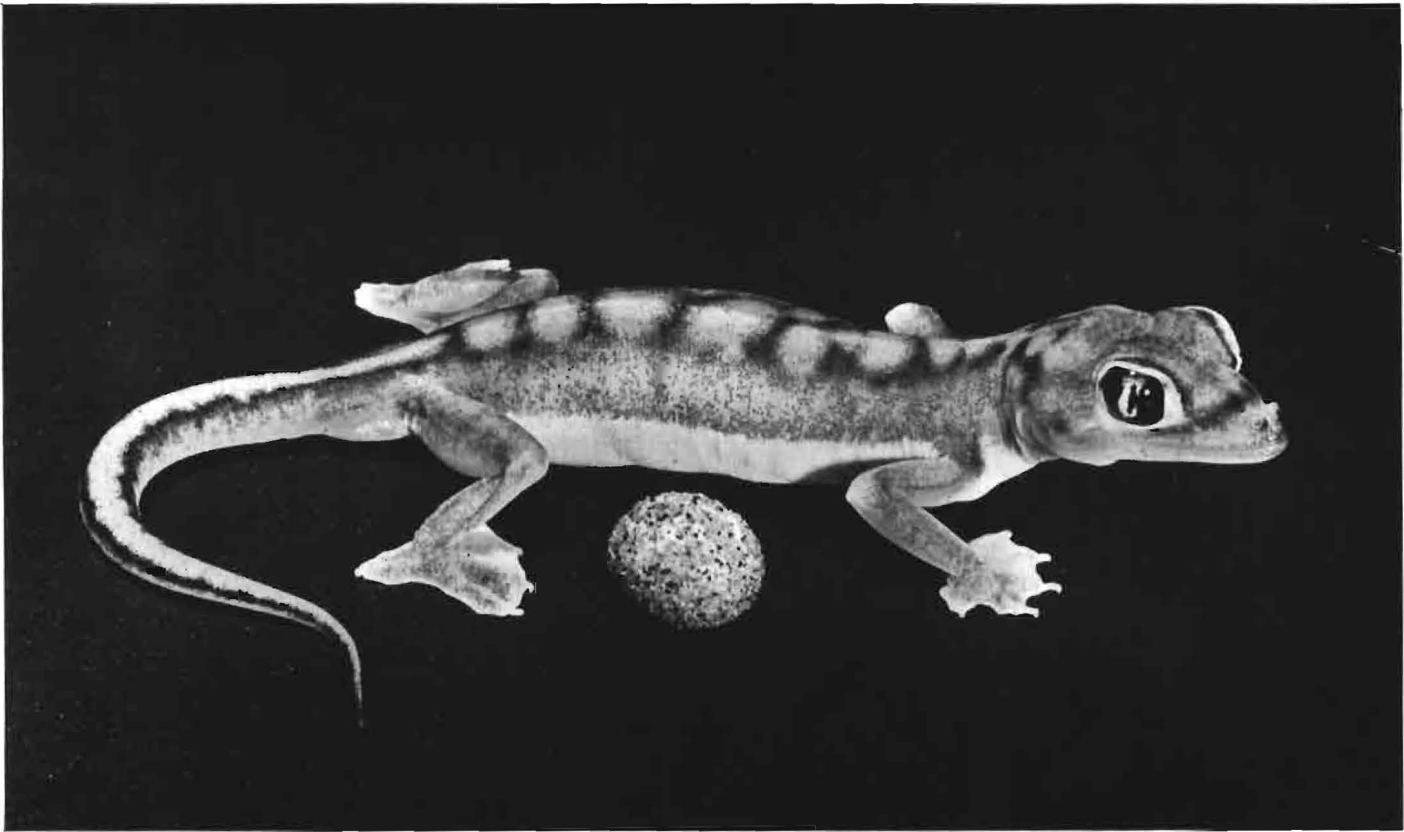


PLATE 1. *Palmatogecko rangei* female from Gobabeb with sand encrusted egg.