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*EREMIASCINCUS*, A NEW GENERIC NAME FOR SOME  
AUSTRALIAN SAND SWIMMING SKINKS  
(LACERTILIA: SCINCIDAE)

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INTRODUCTION

Work on the systematics of any group of organisms above the species level has generally focused on the genus. Historically, this has been due in large part to the imperative of binomial nomenclature, i.e., every species must be placed in a genus, and, more recently, it has been due to the realization that the genus is an extremely useful biological concept when viewed as a monophyletic group of species showing strong morphological and ecological cohesiveness. A sound systematics at the generic level thus has both great practical and theoretical importance in the study of any group.

G. A. Boulenger (1887) established the foundations for the modern study of the systematics of scincid lizards in the third volume of his *Catalogue of Lizards*. In this work, Boulenger endeavoured to place all the known scincid species into rigorously diagnosed, monophyletic genera. To his apparent frustration, however, Boulenger was left at the end of his study with a large and diverse group of species that resisted further subdivision on the criteria he had applied to other genera. This group required a generic name, of course, and the name available was the now famous, or infamous, *Lygosoma*. Boulenger was not content with stopping at the required generic name, however, for to do so would have meant stifling his views on the several lineages hidden under the one name. Instead, he gave the different subgroups of *Lygosoma* subgeneric names, a procedure that was unprecedented in his treatment of other reptile groups<sup>1</sup>.

Much of the subsequent history of skink systematics has been the relentless chipping away at this residual group of refractory skinks, often along the lines suggested by Boulenger's subgenera (Smith 1937, Mittleman 1952, Storr 1964 and Greer 1974 and 1977). In M. A. Smith's time (1937) this group was still known as *Lygosoma* but inevitably this name was applied to one of the small groups that was separated from the core, and the core then came to be known as *Sphenomorphus* (Mittleman 1952), the name by which it is known at present.

1. One of the consequences of combining a large number of species that had previously been described under other generic names into a single genus, of course, was to create many secondary homonyms. This in turn required many replacement names. Under Article 59C of the International Code of Zoological Nomenclature these replacement names must be retained as the species are parcelled out into new and resurrected genera. However, in that Boulenger and all subsequent workers have been convinced that this genus contains several lineages that are equivalent to other genera but more difficult to diagnose, it would be appropriate for the Commission to suspend Article 59C with regard to *Lygosoma*.

It is important to note, however, that even though skink systematics is still plagued by a large and diverse refractory core, there has been a fundamental advance with regard to the composition of that core between Boulenger and M. A. Smith's time and our own. The difference is that whereas formerly the core comprised skinks from more than one basic stock, today it is largely comprised of the representatives of a single stock (Greer 1974 and in prep.). Several lineages are clearly evident in the group (Greer and Parker 1967 and 1974) and current work is focusing on these subgroups. The formal recognition of these taxa, however, is fraught with difficulties.

One of the main difficulties in subdividing *Sphenomorphus* is that, like any other residual group, it encompasses a group of species that share an inordinately large number of characters that are either primitive or difficult to interpret in terms of their phylogenetic polarity. Hence the search for new characters and the interpretation of old ones are becoming increasingly esoteric.

A second problem with according formal taxonomic recognition to the subgroups of *Sphenomorphus* is that the few clearly derived character states which are evident in the most distinctive members of the suspected lineages often grade gradually and discordantly into primitive character states in related species. Many species of the *variegatus* species group, for example, are clearly derived in having (1.) a well developed secondary palate due to the extensive medial apposition of the palatal rami of the pterygoids, (2.) no supranasal scales, and (3.) more than two supraoculars in contact with the frontal scale on each side (Greer 1974). Unfortunately, however, it is easy to arrange a structural series of obviously closely related species that link these highly derived species with species that show these characters in their most primitive states. This variation obviously makes it difficult to draw the clear morphological boundaries that characterize most other skink genera.

Given these kinds of problems, therefore, it seems likely that a rigorous systematic subdivision of *Sphenomorphus* is going to come only through a series of detailed analyses of the different lineages. This paper is, in fact, an attempt to provide such an analysis for one of these lineages.

Although it is impossible at present to diagnose *Sphenomorphus* on the basis of a suite of derived characters and a distinctive ecology, it is possible to describe the group's salient morphological and ecological characteristics as they have come to be recognised, largely by default, over the last few years.

*Sphenomorphus* is a member of the subfamily Lygosominae (Greer 1970), and within this group its closest relatives appear to be the following genera: *Ablepharus*, *Anomalopus*, *Ateuchosaurus*, *Ctenotus*, *Eremiascincus* (named for the first time in this paper), *Hemiergis*, *Isopachys*, *Lerista*, *Lipinia*, *Lobulia*, *Notoscincus*, *Prasinohaema*, *Saiphos*, *Scincella* and *Tropidophorus* (Greer 1977 and 1979). *Sphenomorphus* can be distinguished from all of these relatives by the following combination of characters: supranasal scales usually absent, but present in some species<sup>1</sup>; lower eyelid generally scaly, but with a window in a few species; limbs generally pentadactyl but with a reduced number of digits in a few species; no comb-like auricular projections; dorsal scales smooth or only moderately keeled, never strongly keeled; no continuous longitudinal

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1. The genus *Otosaurus* has been separated from the core group of *Sphenomorphus* on the basis of the presence of a supranasal scale and/or the upper element of a double anterior loreal (Smith 1937 and Mittleman 1952). This seems unjustifiable, however, for two reasons. First, these scales are variable both between and within species, and second, the supranasal, certainly, and the upper anterior loreal, possibly, are primitive instead of derived characters and hence unsuitable by themselves for diagnosing taxa within the group.

ridges along the posterior part of the body and tail; dorsal body pattern featuring neither alternating series of light and dark longitudinal stripes nor strongly contrasting light and dark crossbands (except in a very few species).

The group comprises approximately 125 known species and occurs from southern and eastern Asia through the Indo-Australian Archipelago to the Solomon Islands and Australia; it also probably occurs in Middle America (Greer 1974).

The group occurs in a variety of habitats, but it is generally absent from deserts. Most species are surface dwelling to fossorial; arboreal forms are exceedingly rare. Activity times vary interspecifically from diurnal to nocturnal and the mode of reproduction may be either oviparous or viviparous.

#### RECOGNITION OF A NEW GENUS OF SKINKS

One of the most distinctive subgroups within *Sphenomorphus* is the *richardsonii* – *fasciolatus* complex of Australia (Storr 1974). This complex has a morphology and ecology that is virtually unique in *Sphenomorphus* and hence in my view deserves separate generic recognition. I therefore propose to erect a new genus for this complex, called:

#### **Eremiascincus** New Genus

TYPE SPECIES: *Hinulia richardsonii* Gray 1845. Catalogue of the Specimens of Lizards in the Collection of the British Museum, p.271.

DIAGNOSIS: *Eremiascincus* differs from *Sphenomorphus* in possessing the following combination of morphological traits: (1.) a series of low rounded dorsal ridges extending from the body, where they may occasionally be reduced or absent, onto the tail, and (2.) a pale yellow or off-white to medium brown ground colour with dark brown crossbands on

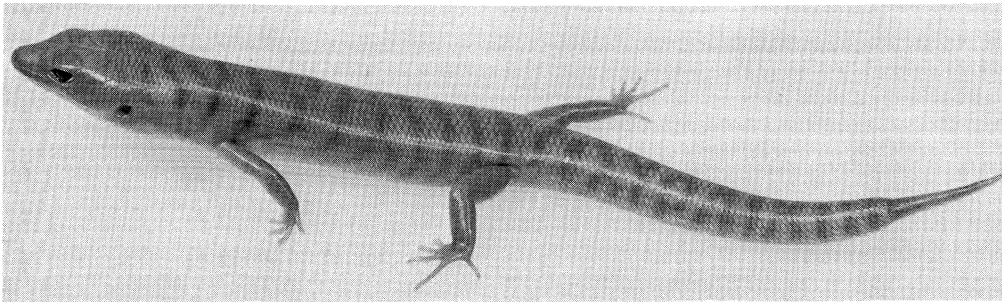


Fig. 1. *Eremiascincus richardsonii* (A.M. 54808) from the vicinity of Caranbirini Waterhole, McArthur River area, Northern Territory. SVL of specimen = 100 mm. Photo: H. G. Cogger.

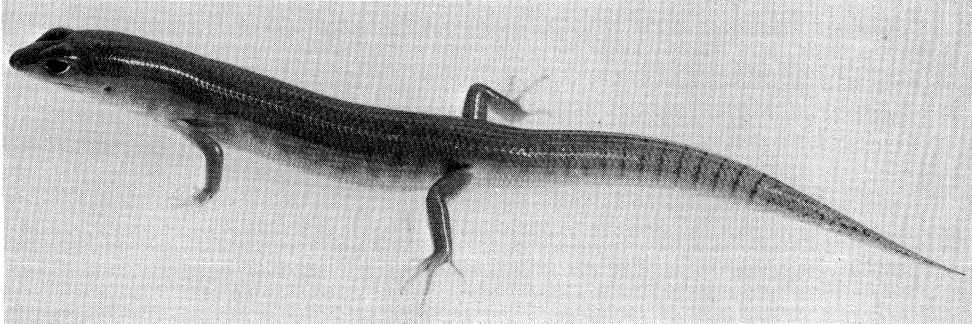


Fig. 2. *Eremiascincus fasciolatus* from approximately 105 miles N. of Carnarvon, Western Australia. Photo: H. G. Cogger.

the body and tail, although the bands may be restricted to the tail or absent altogether in some populations (Figures 1-2).

To my knowledge only *Sphenomorphus gracilipes* of southwestern Australia has dorsal ridges similar to *Eremiascincus* but these are only weakly developed when expressed at all. This species also differs significantly from *Eremiascincus* in body size, limb proportions, colour and habitat (see below).

Species in the *fasciatus* species group of *Sphenomorphus* (Greer and Parker 1967 and 1974) often have a crossbanded pattern, but rarely is it as strongly developed as in the banded populations of *Eremiascincus*, and to my knowledge no species of *Sphenomorphus* ever has a uniformly pale colour pattern similar to those populations of *Eremiascincus* that lack crossbands.

*Eremiascincus* also differs ecologically from all other *Sphenomorphus* in being the only members of this group to have invaded a desert environment.

**ETYMOLOGY.** The name *Eremiascincus* is derived from the Greek word for desert (eremias) and the Latin word for lizard (scincus). The name should emphasize the unique habitat that the genus occupies, at least in part, *vis-a-vis* its relatives. It may also call to mind the parallel between these lygosomine skinks and the scincine skinks of the genera *Scincus* and *Scincopus* of North Africa and southwest Asia which they resemble somewhat in certain aspects of colour pattern, habitat and behaviour.

**SPECIES INCLUDED.** Storr (1967 and 1974) has recently revised the group and recognised two species: *richardsonii* Gray 1845 and *fasciolatus* Günther 1867. The two species occur widely in the arid and semi-arid areas of Australia (Figure 4), and over their

entire range they are distinguished from each other primarily on the basis of the number and pattern of the caudal bands, and to a lesser extent by the number and pattern of the dorsal bands and by the relative length of the tail (Table 1). There is broad overlap in the last two characters, however, and it would not be surprising to find overlap in the first character as the number of specimens with complete tails increases<sup>1</sup>.

In certain areas such as "in the centre of the continent, the species approach each other in so many characters that we can only conclude that gene flow has not long ceased between them" (Storr 1974:70). In other areas, however, notably in extensive sandy habitats, such as in the Pilbara of northwestern Western Australia (Storr 1967 and 1974) and the salt lake — sand dune country of northeastern South Australia (pers. obs.), *fasciolatus* forms distinctive "ecotypes" (Storr's term) that are sharply distinguished from neighbouring populations (which are generally identifiable as *richardsonii*) by both the loss of the dark dorsal bands on the body (and on the tail in the Lake Eyre "ghost skink") and a depressed snout. In addition, there is a good deal of as yet only poorly understood variation in other important characters, e.g., the number of supralabials, the number of infralabials contacted by the postmental, the number and length of the scale rows covering the fourth toe, the length of the exposed portion of the postorbital bone in the supratemporal arch and the degree of development of the ectopterygoid process (see below). These problems raise the possibility that despite Storr's monumental efforts with the species systematics of this group more remains to be done.

**DESCRIPTION:** The skinks of this genus are of medium size (maximum snout-vent length = 113 mm) with well developed pentadactyl limbs and a tail that is 1.1 — 1.7 times the snout-vent length.

In terms of the external characters that are often of systematic importance in other lygosomines, the genus may be characterized as follows: supranasal scales lacking, prefrontal scales large and either meeting medially or not; four supraocular scales, first two or three in contact with frontal; frontoparietal and interparietal scales distinct; parietal scales meet behind interparietal; enlarged nuchal scales 0-4 on each side; anteriormost nuchal separated from upper secondary temporal along posterolateral edge of parietal by one or more scales; lower eyelid scaly; iris virtually as dark as pupil; postmental in contact with either one or two infralabials on each side; external ear opening moderate in size and without enlarged lobules (Storr 1967 and 1974 and personal observation).

All mid-dorsal body scales similar in size or scales of paravertebral rows only slightly wider than those in more lateral rows; medial pair of preanal scales moderately enlarged; dorsal surface of fourth digit covered by two or more longitudinal rows of scales for at least the length of the basal phalange.

The osteological characters in the skull that are potentially important for systematic purposes are as follows: total number of premaxillary teeth generally nine but less frequently eight (Table 2); frontal forms broad surface suture with maxilla; lacrimal present; postorbital present, varying in size from moderate to long, in which case it reaches the supratemporal fenestra, but often only exposed laterally for a short distance in the supratemporal arch (Figure 3 and Table 2); palatal rami of pterygoids expanded anteriorly but generally not meeting medially (Fig 3); pterygoid teeth absent; process from ectopterygoid extending anteriorly along anterolateral edge of palatal ramus varying from nonexistent to strong, in which case it completely excludes the palatal ramus from a position on the infraorbital vacuity (Figure 3 and Table 2); Meckel's groove open; angular completely distinct.

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1. Specimens with complete tails comprise only about 24 percent of the 190 specimens in the Australian Museum, National Museum of Victoria and the South Australia Museum (pers. obs.)

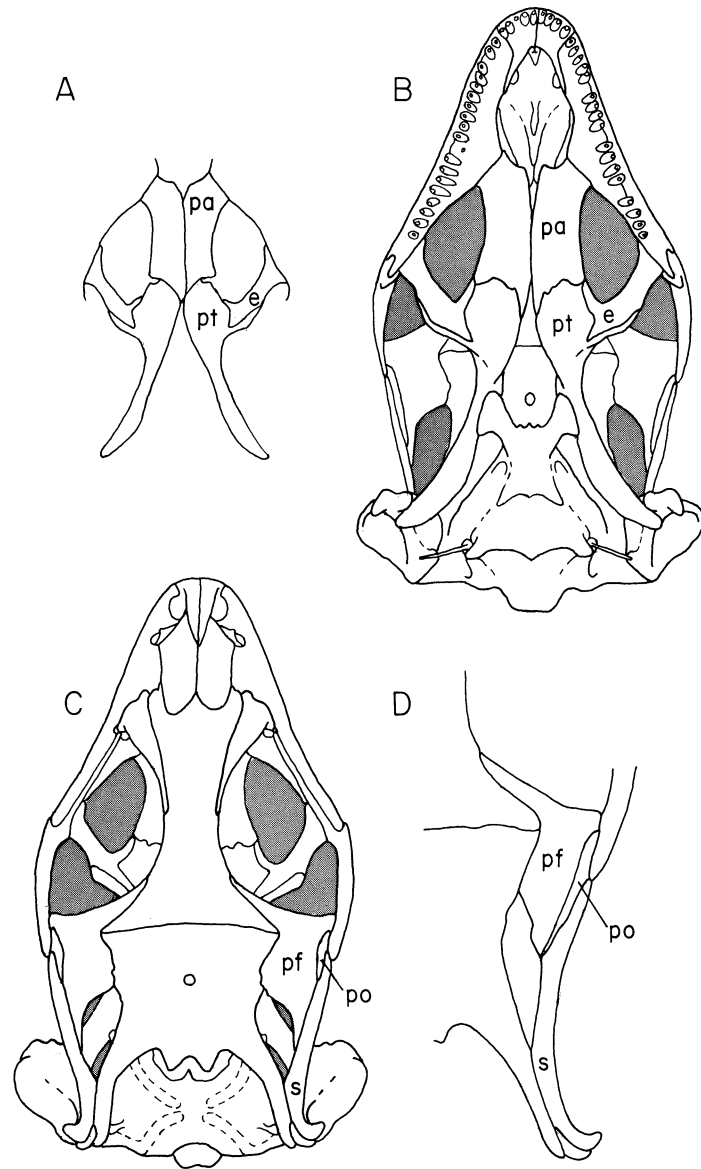


Fig. 3. Dorsal and ventral views of the skull of *Eremiascincus fasciolatus*. Whole skull (B and C) of W.A.M. 24144 and a detail of the palate of A.M. 57093 (A) and of the supratemporal arch of A.M. 57269 (D; partially reconstructed). Note the variation in the degree of development of the ectopterygoid process in the palate (A and B) and in the length of the surface exposure of the postorbital in the supratemporal arch (C and D). The length of the whole skull is 17 mm. Abbreviations: e — ectopterygoid; pa — palatine; pf — postfrontal; po — postorbital; pt — pterygoid, and s — squamosal.

It may be noted that much of the morphological and osteological variation described above would be indicative of species differences in many other skink groups including *Sphenomorphus*. To the extent that I have been able to apply current criteria for species identification in *Eremiascincus*, however, none of the variable characters serve to distinguish the two species in any absolute sense. The degree of development of the ectopterygoid process, however, may be partially diagnostic; in all specimens of *richardsonii* examined for the character, the process extended all the way to the palatine to completely exclude the palatal ramus from a position on the infraorbital vacuity (a condition indicated by the number 1 in Table 2; Figure 3B) while in most *fasciolatus* the ectopterygoid extended only part way to the palatine (indicated by a fraction in Table 2; Figure 3A).

**DISTRIBUTION:** *Eremiascincus* occurs throughout most of the arid and semi-arid interior of Australia (Figure 4). It is generally absent from most of the more mesic fringe along the north, south and east coasts of the continent, although it does apparently come onto the coastal plain in certain parts of southeastern Queensland, e.g., Rockhampton (Günther 1867), Port Curtis (A.M. 6382-6384, Q. M. 1837) and Ipswich (Q.M. 25430-25433).

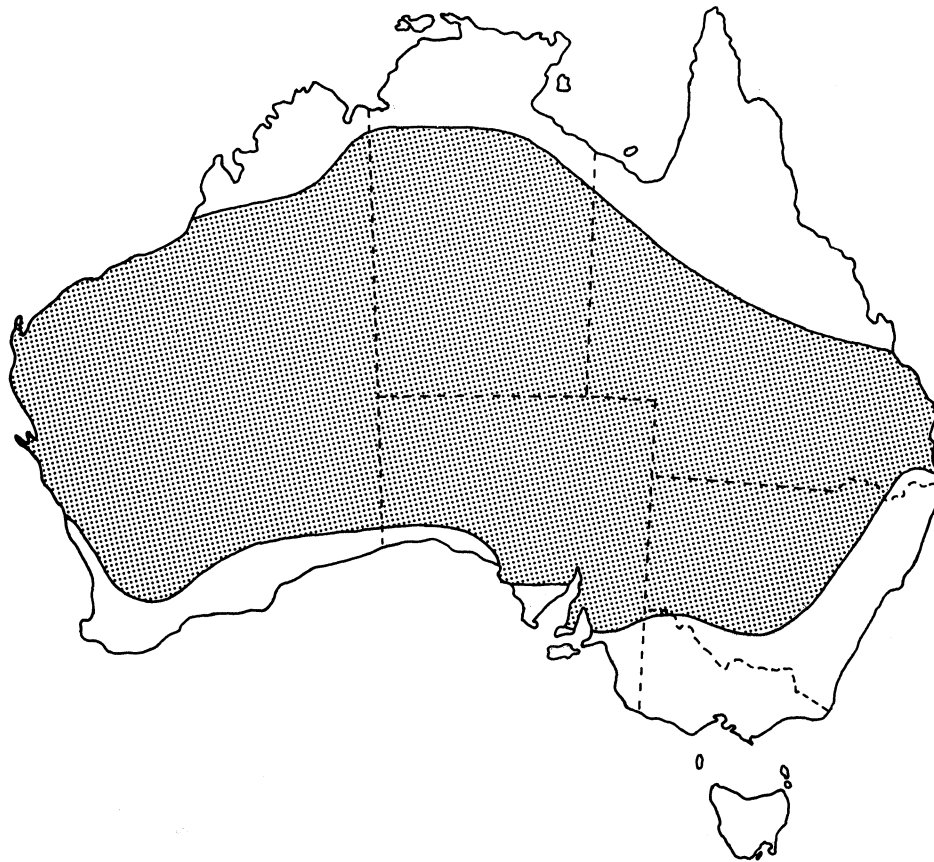


Fig. 4. The distribution of *Eremiascincus*.



As far as I have been able to determine, there are no specimens from north of a line between Bedourie and Rockhampton in Queensland, although Mr Peter Rankin (pers. comm.) reports having seen an individual (species uncertain) approximately 10 miles S.E. of Cloncurry. On the basis of both this sight record and the taxon's wide distribution elsewhere, I have drawn the distribution to include northcentral Queensland, but clearly an effort should be made to obtain specimens in this area before this part of the distribution can be accepted with confidence.

**HABITAT:** In his original paper Storr (1967) suggested that *richardsonii* and *fasciolatus* might have different habitat associations: *richardsonii* being associated with hilly or rocky country and *fasciolatus* being associated with plains and sand dunes. Unfortunately little new information seems to have been recorded on the habitat associations of *Eremiascincus*, but the information that has come to light tends to support Storr's suggestion. Storr himself received additional specimens that tended to confirm his views, e.g., three *richardsonii* from the upper courses of creeks flowing north from the Petermann Ranges and a single *fasciolatus* from a few miles further down one of these creeks "where the Armstrong loses itself among the sand dunes south of Lake Amadeus" (Storr 1974).

With regard to *richardsonii*, two ecological surveys are especially relevant to the question of habitat associations. In the first of these, Pianka (1969) studied in detail the ecological relationships of the lizards at eight different localities in southwestern Australia. The localities were chosen specifically for their different habitats, and although all the localities were well within the range of *richardsonii*, the species was encountered at only one site (Y): "a lake-bed community consisting primarily of chenopodeaceous shrubbery". The species was not encountered at any of the other localities which, notably, had been chosen to represent sandplain *Triodia* habitat and sandridge habitat.

More recently, Smith (1976) surveyed the reptiles of Barrow Island, Western Australia and noted that *richardsonii*, the only *Eremiascincus* encountered, was found only in the *Triodia* covered rocky areas that constitute about 80 percent of the island and not in the sandy areas that constitute the remaining 20 percent.

There are also some additional observations on *richardsonii* based on incidental observations of field collectors. At Brewarrina, New South Wales, for example, Mr Peter Rankin and his associates found seven specimens under isolated surface cover in a flat open area. There was no soft soil suitable for burrowing in the area and the animals retreated down unused mouse holes when uncovered. Mr Rankin also found single specimens of *richardsonii* near Blackall (A.M. 60003) and Charleville (A.M. 60002) in Queensland that were in areas of hard packed red soil. I can also personally report finding a single specimen (A.E.G. 98) that is probably identifiable as *richardsonii* (most of the tail is regenerated) under a log in the sandy bed of the Hugh River in rocky country approximately 51km west of Alice Springs. Dr Terry Houston (pers. comm.) has found *richardsonii* in the stony foothills of the Peake Denison Range west of Lake Eyre where there was no sandy terrain, only gibbers, within a kilometre of the site. He also notes, however, that most of his encounters with the species elsewhere occurred in red sand areas.

Most of the new information for *fasciolatus* comes from museum labels and collectors' field notes. One specimen in the South Australian Museum (S.A.M. 11175) was said to have been collected "in a small burrow in a sandy hummock" while a second (S.A.M. 11176) was said to have come from an area of "red soil with spinifex". Dr Houston writes that his brief encounters with *fasciolatus* were in the red sandridge country east of Lake Frome.

Mr Rankin has also collected *fasciolatus* on several occasions and has generously summarized his notes for me. He obtained one specimen (A.M. 59307) in the bottom of a well on the floodplain of the Darling River in southwestern New South Wales in an area with sand mounds scattered over an otherwise heavy alluvium. Shortly thereafter two juveniles were caught at the same locality in loose dry sand beneath tin. He was also present when another specimen (A.M. 61210) was dug out of a burrow in a very loose sand bank in a white sand area east of Menindee. Mr Rankin has also collected a single juvenile (A.M. 52066) near Tea Tree Roadhouse in the Northern Territory under a sheet of iron in an area of loose sand noted to be lacking in "stony elements". Three other specimens taken at Ellery Creek near Hermannsburg in the Northern Territory were caught under fibro on loose sandy soil; one of these specimens was buried in the loose soil under the fibro. Finally, I have taken a single specimen (A.E.G. 368) lacking body bands in a can trap along a drift fence set across a red sand dune some 62 km west of Ayers Rock by road.

The association with loose sandy soils implied by these records is not perfect, however, for Mr Rankin notes that three *fasciolatus* collected at Tanami Bore in the Northern Territory and now in the collections of the Museums and Art Galleries of the Northern Territory were under sheets of iron on a very hard stony soil that was typical of the area; it was also specifically noted that there was no loose soil anywhere in the immediate vicinity.

It thus appears that Storr's observations of generally distinct habitat associations for *richardsonii* (hard, rocky country) and *fasciolatus* (sandy areas) are borne out by the available additional observations. At the same time, however, the relatively small sample sizes and the few "exceptions", e.g., Dr Houston's experiences with *richardsonii* in red sand areas and Mr. Rankin's observations of *fasciolatus* on hard stony soil, make it clear that the observations need to be extended. It would be extremely useful, therefore, if in the future, collectors would record both the general habitat and the specific substrate for each specimen of *Eremiascincus* collected.

**BEHAVIOUR.** The forms of *Eremiascincus* are uniformly reported in the literature as being crepuscular (Houston 1973) or nocturnal (Worrell 1963, Pianka 1969 and Cogger 1975) in their occurrence at the surface. By day they are generally found under surface cover such as pieces of exfoliated granite, logs and roofing tin, or in burrows. With regard to this last retreat, *richardsonii* has been found in caves and deep crevices (Smith 1976), unused mouse burrows (Rankin, pers. comm.) and rabbit burrows (Houston 1973) and *fasciolatus* has been found "in a small burrow in a sandy hummock" (S.A.M. 11175), in an *Egernia kintorei* warren (S.A.M. 11176) and in rabbit burrows (Houston, pers. comm.). One of the most effective methods of collecting either species, in fact, seems to be by setting can traps in the loose soil in the mouths of rabbit burrows.

Mr Rankin has kept a single *Eremiascincus fasciolatus* and three *E. richardsonii* in captivity and has made the following interesting observations which he has kindly allowed me to publish. He notes that the animals stayed hidden beneath the loose substrate by day but appeared at the surface at dusk. This appearance would, however, be limited to exposing only the top part of the head and eyes while the rest of the animal remained buried. From this position the animal would hurl itself out of the substrate and onto any prey that happened to pass close by. Dr Houston also informs me that *richardsonii* in captivity immerses itself in loose sand to escape or to rest.

Both species of *Eremiascincus* are sand swimmers (Dr H. G. Cogger, Dr T. Houston, Mr P. Rankin pers. comms. and pers. obs.). Dr Houston reports that an acquaintance of his found specimens of *fasciolatus* by following tracks on sand dunes and digging down a few inches where they ended. This same person also told Dr Houston that *fasciolatus* "threaten" each other at feeding time with rapid vibrations of the tail.

It is interesting to note that in contrast to certain other arid adapted, nocturnal skinks such as the North African scincine *Scincopus fasciatus* and certain central Australian *Egernia* which have a vertically elliptic pupil (Mertens 1972 a and b), *Eremiascincus* has a circular pupil (pers. obs.).

**REPRODUCTION.** The only published information of the mode of reproduction in *Eremiascincus* pertains to *fasciolatus*. Unfortunately, however, this information is replete with inaccuracies and ambiguities. Waite (1929) appears to have started the problem when he quoted in full under the heading of *Hinulia fasciolata* some observations by Lucas and Frost on a female that gave birth to four young. Lucas and Frost (1894), however, made their remarks under the heading of *Hinulia quoyii*, a well known viviparous species. It is difficult to understand how Waite made the mistake of confusing *quoyii* and *fasciolatus* as the two species have never been confused in the past, and the locality of Lucas and Frost's female — Noojee in the eastern highlands of Victoria — is far outside the range of *fasciolatus* (but well within the range of *quoyii*). Waite's account of *fasciolatus* immediately follows his account of *quoyii* so perhaps the Lucas and Frost quote was misplaced.

Worrell (1963) states that *fasciolatus* is "viviparous, producing four young". In a letter (25 Oct. 1976) replying to a request for confirmation of this observation, Mr. Worrell's assistant Mrs. L. M. Abra says that Mr. Worrell did indeed have "a specimen that gave birth", but in a letter (25 Feb. 1977) replying to a request for collecting data for this specimen, she says that it was collected in the "Cairns District". The Cairns area, however, is far outside the known range of *Eremiascincus* (Figure 4), and hence the identity of the specimen and the accuracy of Worrell's observation is in doubt.

Bustard (1970) notes that *fasciolatus* "gives birth to live young", and Rawlinson (1971) lists the species as being "viviparous". I have not been able to trace the origin of Bustard's statement, but Rawlinson (pers. comm.) attributes his information to a personal communication from the late John Mitchell of South Australia. Where Mitchell obtained his information is not known, but it is worth noting that there are no preserved *fasciolatus* in the collections of the South Australian Museum that are identified as having been born in captivity. In summary, therefore, there seems to be little reliable information in the literature on the mode of reproduction of *fasciolatus*.

In an effort to learn more about the mode of reproduction in *Eremiascincus*, I examined all of the Australian state museum collections for gravid females. This involved more than 300 specimens and out of these I found seven females gravid with either enlarged (yolking or yolked) ovarian eggs or oviducal eggs (Table 3). All specimens were identifiable as *richardsonii*. Only two females had oviducal eggs and in both, the eggs were surrounded by a distinct opaque shell. The texture of these shells implied to me that the eggs would have been laid. It would thus seem that on the basis of present information *richardsonii* is oviparous and the mode of reproduction of *fasciolatus* is unknown, although there is the possibility that it is viviparous. If *fasciolatus* were viviparous, it would be one of the clearest indications that two distinct populations exist within *Eremiascincus*. For this reason, unambiguous information on the mode of reproduction in *fasciolatus* would be a most important contribution to our knowledge of the biology of these lizards.

**RELATIONSHIPS.** The relationships of *Eremiascincus* within the diverse complex of skinks now recognised as *Sphenomorphus* are not entirely clear but certain trends are evident and these are discussed below.

Within the Australian Region there appear to be two major species groups within *Sphenomorphus*: the *variegatus* species group and the *fasciatus* species group (Greer and Parker 1967 and 1974). These two groups are not absolutely distinct, but there are at least

eight characters that help to distinguish them and which can be used to evaluate *Eremiascincus*' broad relationships.

1. The *variegatus* group often has supranasal scales and/or a double anterior loreal whereas the *fasciatus* group almost always lacks supranasals and double anterior loreals. *Eremiascincus* also lacks these scales.

2. The *variegatus* group often has three or more supraoculars in contact with the frontal on each side whereas the *fasciatus* group rarely has more than two (three at maximum). In *Eremiascincus* three supraoculars often contact the frontal.

3. In the *variegatus* group the scales in the paravertebral rows are generally equal in size to or only slightly larger than the scales in the more lateral rows whereas in the *fasciatus* group the scales in the paravertebral rows are often, but not always, transversely enlarged. In *Eremiascincus* the mid-dorsal scales are equal in size or the scales in the paravertebral row are only slightly enlarged.

4. The *variegatus* group only rarely shows a pattern of dorsal crossbands, but this pattern occurs albeit often subtly, in the *fasciatus* group. These patterns may be related to the modal activity times of the two groups (see item 8 below). *Eremiascincus*, of course, is noted for its distinct crossbands.

5. The *variegatus* group rarely has an ectopterygoid process, but this process occurs frequently in the *fasciatus* group. Most *Eremiascincus* show some trace of an ectopterygoid process (Figure 3 and Table 2).

6. The palatal rami of the pterygoids are often widely separated in the *variegatus* groups, especially in the more primitive representatives, whereas the palatal rami are usually not separated to any great extent in the *fasciatus* group. In the more advanced members of the *variegatus* group and in most of the *fasciatus* group the palatal rami meet or are closely apposed along their extensive medial edges. In *Eremiascincus* the palatal rami are moderately separate (Figure 3) such that they would be judged intermediate in the *variegatus* group and rather widely separated in the *fasciatus* group.

7. The postorbital bone is always short and never reaches the supratemporal fenestra in the *variegatus* group whereas the postorbital is generally long and thin and reaches the supratemporal, in the *fasciatus* group. The postorbital varies from medium to long in *Eremiascincus* and in some specimens reaches the supratemporal fenestra (Figure 3 and Table 2).

8. Most representatives of the *variegatus* group are active on the surface by day whereas most members of the *fasciatus* group are cryptozoic by day and only active on the surface, if at all, after dark. *Eremiascincus*, of course, is cryptozoic by day, only appearing at the surface after dusk (see Behaviour section above).

With regard to the relationships of *Eremiascincus* with either the *variegatus* group or the *fasciatus* group, character six is somewhat equivocal, characters two and three seem to tilt the decision toward the *variegatus* group, while characters, one, four, five, seven and eight, seem to support a relationship with the *fasciatus* group. On the basis of sheer numerical scores, therefore, *Eremiascincus* seems closest to the *fasciatus* group. Perhaps

even more important, however, is the fact that characters four, seven and eight probably offer the clearest basis for separating the two species groups and in all three characters *Eremiascincus* is closest to the *fasciatus* group. This relationship also receives some support from distributional information in that the *variegatus* group is not certainly represented in the Australian fauna (the *quoyi-tympanum* complex and an undescribed species from eastcentral Queensland may be representatives) whereas the *fasciatus* group is clearly represented by a large number of species.

Having tentatively identified *Eremiascincus* as a probable close relative of the *fasciatus* group of *Sphenomorphus*, it may be useful to discuss those species within this group that are similar to *Eremiascincus*.

To my knowledge *Eremiascincus* shares the diagnostic longitudinal dorsal ridges only with *Sphenomorphus gracilipes* of the extreme southwestern corner of Western Australia. It seems likely, however, that this similarity is convergent, for in *gracilipes* the ridges are only weakly developed at best and in body size and limb proportions, dorsal and ventral coloration, and habitat associations, the two taxa are quite distinct. *Eremiascincus* has a robust body with well developed limbs, generally strongly contrasting dark crossbands on relatively light ground colour and an off-white venter, and generally xeric habitat requirements, whereas *gracilipes* has an attenuate body with greatly reduced limbs, a generally uniformly dark dorsum and yellow venter, and very mesic habitat requirements.

*Eremiascincus* shares its highly contrasting dorsal banding pattern with the poorly known *Sphenomorphus jeudei* (Boulenger's 1914 replacement name for Lidth de Jeude's 1897 *tigrinum*) from northeastern New Guinea. This species differs from *Eremiascincus*, however, in lacking dorsal ridges (at least there is no mention of them in the type description) and, to judge from its general distribution, in inhabiting a very mesic environment. It seems likely, therefore, that *Eremiascincus* and *Sphenomorphus jeudei* have evolved strongly contrasting crossbanded patterns independently.

Apart from these species, there are two other species of *Sphenomorphus* that bear a certain similarity to *Eremiascincus* which may be indicative of close relationship. These are *Sphenomorphus isolepis*, especially as represented by the large-bodied population in the Northern Territory,<sup>1</sup> and *S. nigricaudis* from southern New Guinea, the islands of Torres Strait and Cape York Peninsula (see Figure 5 for the distribution of these two species in Australia). Neither of these species has the diagnostic dorsal ridges of *Eremiascincus* but both are similar to *Eremiascincus* in body size and limb proportions. Neither species has the striking crossbands of *Eremiascincus*, but both species have a dorsal pattern of dark spots that may be oriented transversely. These crossbands are especially prominent in *nigricaudis* but can also be discerned in some *isolepis* as well.

*Sphenomorphus isolepis* also shares some of the characters seen in *Eremiascincus* that are more characteristic of the *variegatus* species group than the *fasciatus* species group, e.g., often three supraoculars in contact with the frontal, subequally sized dorsal scales

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1. My concept of *isolepis* excludes *douglasi* (cf. Storr 1967 and 1972). The two species can be readily distinguished on the basis of the number of the supralabial scale that falls directly below the centre of the eye and colour pattern: *isolepis* generally has the fifth supralabial below the centre of the eye and a colour pattern of distinct spots distributed more or less uniformly over the dorsum whereas *douglasi* generally has the fourth supralabial below the centre of the eye and a distinct dark dorsolateral stripe on a generally unspotted or at least much less heavily spotted dorsum. Both species occur syntopically in certain localities in the Northern Territory (Dr H. G. Cogger pers. comm.), and if *brongersmai* is conspecific with *douglasi*, as I believe it is, then *douglasi* and *isolepis* also occur together in the northern Kimberleys (Storr 1972).

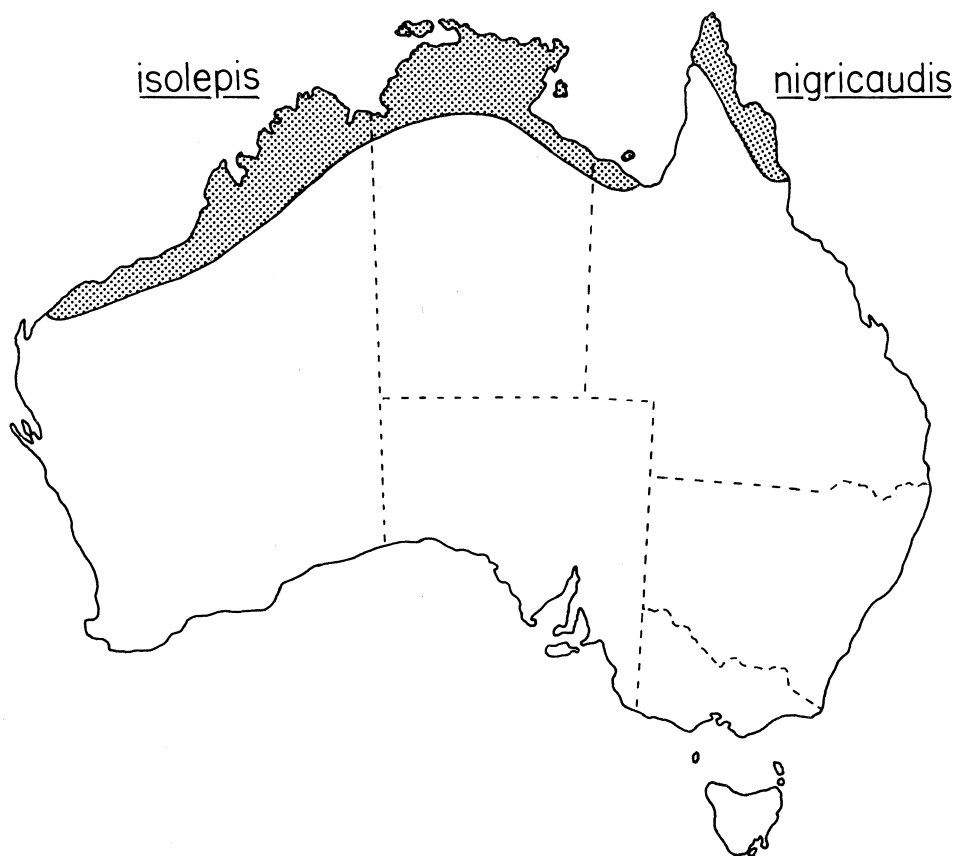


Fig. 5. The distribution in Australia of the two members of the *fasciatus* species group of *Sphenomorphus* that appear to be the closest living relatives of *Eremiascincus*.

and slightly separated palatal rami (although perhaps not as widely separated as in *Eremiascincus*). *S. isolepis* is nevertheless, a typical representative of the *fasciatus* group on other characters: it lacks supranasals, has both an ectopterygoid process and a long thin postorbital (pers. obs), is cryptozoic by day but active on the surface at night (Cogger 1975), and like most other members of the *fasciatus* group it is a litter swimmer.

If *Sphenomorphus isolepis* and *S. nigricaudis* are the closest living relatives of *Eremiascincus*, they are probably most reasonably regarded as conservative derivatives of the lineage that gave rise to *Eremiascincus*. Structurally they are more primitive than *Eremiascincus* in lacking this taxon's unusual dorsal ridging and colour pattern, and ecologically they occur in seasonally dry habitats (savanna to monsoon forest) that may have preadapted their lineage for an invasion of the arid interior.

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Dr H. G. Cogger generously provided the photographs for Figures 1-2.

My wife Phlyp drew Figure 3 and read manuscript for me. She also had a hand in catching the few *Eremiascincus* we've seen in the field.

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#### Note Added in Press

After this paper went to press, I received from Mr Gary Stephenson a single adult *Eremiascincus richardsonii* from 20 km east of Three Ways Roadhouse, N.T. This animal was kept in the laboratory for three months and the following observations made. At first the animal spent most of its time buried in the loose red soil that comprised the substrate of its cage, and it would only appear on the surface during mid to late afternoon. Later, however, it switched its retreat to a newly introduced piece of surface cover and would appear at various times of day to bask with eyes closed and limbs stretched back along its body under an incandescent light placed directly above its cage.

The animal was a voracious predator, attacking and devouring the hatchling geckos, skinks and baby mice that were introduced into its cage. When prey was offered, the *Eremiascincus* would generally remain motionless except for a slow twitching of the end of the tail and then suddenly attack, often going directly for the head of larger lizards. Upon grasping its prey, the animal would often rapidly rotate the entire body and tail around its long axis, presumably to aid in subduing the prey. Pieces of banana and grape were also offered but only the former was eaten. The animal drank readily.



**TABLE 1.** Summary of the characters used by Storr (1974) to distinguish *richardsonii* and *fasciolatus*.

Character	<i>richardsonii</i>	<i>fasciolatus</i>
<i>Dark crossbands on tail</i>	19-32; wider, less regular (often oblique and branching)	35-40; narrower, and more regular (usually one scale wide, perfectly transverse, and separated by interspace of two scales)
<i>Dark crossbands on body</i>	8-14; wider (up to as wide as interspaces), sharper-edged and more strongly contrasting with pale ground colour.	10-19; much narrower than interspaces, often breaking mid-dorsally and not much darker than ground colour.
<i>Tail length</i>	131-171% of SVL	114-142% of SVL

**TABLE 2. Summary of the total number of premaxillary teeth, the degree of exposure of the postorbital bone in the supratemporal arch and the degree of development of the ectopterygoid process in specimens of *Eremiascincus* (see text for details).**

Specimen	Locality		Number of premaxillary teeth	Degree of exposure of postorbital bone in supratemporal arch	Degree of development of ectopterygoid process
		<i>fasciolatus</i>			
A.M. 57269	Rockhampton, Qld.		9	Long	1
A.M. 5317	Upper Burnett River, Qld.		?	Long	?
S.A.M. 9929	Milparinka, N.S.W.		9	?	1/2
A.M. 61210	ca. 9.5 mi. E. Menindee, N.S.W.		9	?	1/2
A.M. 9544	Broken Hill District, N.S.W.		9	Short	0
A.M. 35245	8 mi. N.W. Birdsville, Qld.		9	?	2/5-3/5
A.M. 57093	Cluny Sta., Bedourie, Qld.		9	Short	2/5
W.A.M. 24144	4 mi. S. Larrimah, N.T.		9	Short	1
M.C.Z. 35442	Hermannsburg, N.T.		9	Short	1/2
N.M.V. 467	Illamurta, James Range, N.T.		8	?	1/3
		<i>richardsonii</i>			
Q.M. 11984	Waratah, Cunnamulla, Qld.		?	?	?
A.M. 42151	Sturt Nat'l. Park, N.S.W.		9	Short	1
S.A.M. 15465	Silverton, N.S.W.		9	?	1
A.M. 2117	Central Australia		8	Long	1
A.M. 7141	Mt. Lyndhurst, S.A.		8	Short	1
N.M.V. 41999	3 mi. S. main Ord River dam site, W.A.		9	?	1
W.A.M. 17894	Woodstock, W.A.		9	Medium	1
Q.M. 1838	Western Australia		?	?	0
		Identification uncertain			
A.M. 2115	Central Australia		9	Medium	1

SAND SWIMMING SKINKS

**TABLE 3. Summary of information on body size, clutch size, locality, and date of collection for *Eremiascincus richardsonii* gravid with either enlarged (yolky) ovarian eggs ("o") or oviducal eggs.**

Specimen	SVL (mm)	Number of eggs on right (R) and left (L) side and total	Locality	Date
W.A.M. 40772	—	3R — 1+? = 4 + ?°	4 mi. S. Old Lissadell H.S., W.A.	4 Oct. 1971
W.A.M. 25103	116	3R — 4L = 7°	Woodstock Station, W.A.	Nov. 1959
W.A.M. 30855	95	2R — 4L = 6°	Marloo Station, W.A.	2 Feb. 1968
S.A.M. 993A	79	2R — 2L = 4°	Kingoonya, S.A.	—
S.A.M. 164A	88	ovarian eggs	Beverley, W.A.	—
S.A.M. 15067A	79	2R — 1L = 3	3 km.N.E. Arcoona H.S., S.A.	25 Nov. 1975
W.A.M. 17891	104	2R — 1L = 3	Woodstock, W.A.	Mar. 1958