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The Anura of the Etosha National Park

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ABSTRACT

A survey of the Etosha National Park was carried out to compile a checklist of its amphibian fauna. Out of the approximately 127 anuran species in southern Africa, only 10 were found within the boundaries of Etosha. Of these, Hildebrandtia ornata, is represented by one specimen, which is only the third such frog to be recorded from South West Africa. Rather surprising is the absence of Xenopus. It is suggested that not only the relatively low and fluctuating annual precipitation, but also the chemical composition of many of the free waters, account for the scarcity of different anuran species.

The taxonomy, distribution, habits and breeding behaviour of each species occurring in the area are given.

1 INTRODUCTION

Game parks are synonymous with recreation, and since tourism centres mainly around the larger mammals and birds, research in game parks too, centres around the larger animals, neglecting the herpetofauna and invertebrates. The extremely important rôle which the smaller animals play in nature’s equilibrium, need not be stressed. Insects alone account for about 76% of the whole animal kingdom, mammals and birds for about one per cent.

One of the first priorities in any game park should be to compile floral and faunal checklists. Shortage of research workers as regards their own personnel hampers game parks to implement this fully. In this respect the Division of Nature Conservation and Tourism in South West Africa must be congratulated for its attitude of close co-operation with other research institutions.

2 SURVEYING AND COLLECTING

The survey started in April 1974 and up to December 1975 five trips were made, each lasting up to two weeks. These visits to Etosha were during the months of November to May, thus covering the rainy season. During each trip as many fountains, pools, wells, reservoirs and drinking troughs as possible were visited with the kind co-operation of the staff of the Division of Nature Conservation and Tourism. Many specimens were brought back to Stellenbosch for identification. The tadpoles were all identified microscopically.

Five visits were not sufficient to make a really complete survey, and in this respect staff members of Nature Conservation and Tourism stationed in Etosha, made a valuable contribution. In addition the collection of the Ecological Research Institute at Okaukeujo also proved to be of help. Although during the survey no Phrynomerus bifasciatus was found, Mr. B. J. G. de la Bat, the present Director of Nature Conservation and Tour-
ism in South West Africa, collected a single specimen at Namutoni in May 1961. This frog (SM. R. 25077) is part of the anuran collection in the State Museum, Windhoek. The specimens collected will become part of the herpetological collection of the Ecological Research Institute at Okaukuejo.

The rarest specimen collected during the survey was a specimen of *Hildebrandtia ornata*.

3 **ECOLOGY**

It is well known that the only representatives of the class Amphibia south of the Sahara, are the anurans and the gymnophiones. Only the Anura occur in Etosha. The environmental adaptations of members of this order vary from being completely aquatic, as in *Xenopus*, to the other extreme of terrestrialism as in *Brevicleps*, where no free water is needed for the life cycle to be completed.

The enormous Etosha National Park covers 22,720 square kilometres. There are more than a hundred permanent waterfowl, reservoirs and drinking troughs. During the rainy season numerous small pans, vleis, water-holes and excavations become filled, holding water for several months. In addition, in years with a high precipitation the *Okonjim* drain the Etosha catchment area, which covers about 130,000 square kilometres, flowing into the Okavango and Okolongo rivers which feed the Etosha Pan. From the north-east the Omuramba-Ovambo dunes drain into Fisher’s Pan, eventually also feeding the Etosha Pan. Thus, in some years the Pan is transformed into an enormous lake, holding water for several months.

The Etosha catchment basin reaches northwards as far as the Sierra丝毫 Mountains (some 300 kilometres inside Angola) and one must expect some continuity in the anuran fauna between Etosha, Ovamboland and southern Angola. This is indeed manifested in the presence of *Hildebrandtia ornata* in Etosha.

It is clear that Etosha is a relatively water-rich area. Nevertheless only 10 species out of the approximately 127 species of anura in southern Africa were collected during the survey. I do not expect this figure to rise above perhaps 15 after future surveys. By comparison, the Kruger National Park is inhabited by 33 species.

The reason for the relative scarcity of different anuran species in Etosha probably lies not only in the annual rainfall and the low number of different habitats, but also in the chemical composition of the fountains and other waters. The annual precipitation, which fluctuates greatly from year to year, averages 450 to 500 mm in the Namutoni area, 425 mm at Okaukuejo, and 300 mm in the Ovovindou area (Hensen and Canning, 1976). Extended periods of drought render Etosha uninhabitable to waterfowl. An analysis of water from Batua, Okonfentein and Okondeka showed pH values of 9.39, 9.21 and 8.92 respectively.

Data on these fountains and many other water sources, kindly put at my disposal by Dr. P. S. Swart, corroborates my analyses of Batia, Okonfentein and Okondeka. In some cases pH levels as high as 9.5 (Rietfontein and Ombika), 9.6 (Aua), 10.0 (Kapupa-hedi) and 10.3 (Olifantshoek) have been recorded. Also, according to the report, high concentrations of various dissolved minerals, in addition to high pH levels, render many of the fountains and other water sources unsuitable for anuran use. The chemical composition of the water may possibly account for the rather surprising total absence of *Xenopus* from the entire Etosha area.

4 **SYSTEMATIC LIST**

**CLASS AMPHIBIA**

**ORDER ANURA**

**SUBORDER PROCOELA**

**FAMILY BUFONIDAE**

Genus *Bufo* Laurenti, 1768
- *B. garmani* Meek, 1897
- *B. verdralis hirschi* Abl, 1934

**SUBORDER DIPLOSTOJOEOLA**

**FAMILY MICROHYLIDAE**

**SUBFAMILY BREVICITIPITAE**

Genus *Brevicleps* Merrem, 1820
- *B. adspersus adspersus* Peters, 1882

**SUBFAMILY PHRYNOCHIELIDAE**

Genus *Phrynomerus* Noble, 1926
- *P. bifaxtaeis bifaxtaeis* (Smith, 1847)
- *P. annaeceus* (Werner, 1910)

**FAMILY RHACIDAE**

**SUBFAMILY RHACIDEAE**

Genus *Ptyxicephalus* Tschudi, 1838
- *P. adspersus* Tschudi, 1838
- *P. adspersus* Günther, 1858
- *T. delalandii cryptidi* (Boulenger, 1907)
Genus *Hildebrandtia* Nielen, 1907
- *H. ornata* (Peters, 1878)

**SUBFAMILY PHRYNOBATRACHIDAE**

Genus *Caecosternum* Boulenger, 1887
- *C. boettgeri* (Boulenger, 1882)

**SUBFAMILY HISTERIDAE**

Genus *Kassina* Girard, 1854
- *K. senegalensis* (Duméril & Bibron, 1841)

5 **SYSTEMATIC ACCOUNT**

5.1 *Bufo garmani* Meek


**Terra typica:** Halleh, Somaliland.

**Type:** In the Chicago Natural History Museum.

**Localities in Etosha:** Gosa, Groet Okevi, Halali and Pan’s Edge.

**Localities elsewhere in SWA:** Kunene River, Grootfontein, Okahandja, Okaharaka, OtjozongULO, Sesfontein, Sissikub, Swakopmund, Tsumkwe, Waterberg and Windhoek (Peyton, 1964); Braitwater, Gobabeb, Omapoko, Okahandja, Okakarab, Onguma (specimens in Windhoek Museum); Omba, Hoiboa, Kapopo (Okaano), Okahandja, Oshikango and Windhoek (Channing, 1972); assuming that the specimens described by Mertens (1955) as B. regularis regularis are in fact B. garnairi (see later), then also Damara, Gammas, Goabfontein, Kaokoveld, Okahandja, Onvango, Oshikango, Oshikango, Rundu and Tsumeb.

**Common names:** Garnair’s Toad (Channing and van Dijk, 1976); Northern Moutled Toad, Noordvleke gevlekte padde (Pienaar *et al.*, 1976).

**Taxonomy:** The excellent works of Peyton (1964) and van Dijk (1971), the latter dealing with the tadpoles, have provided students of batrachian taxonomy with the most useful diagnostic features. With the aid of these characteristics Peyton has shown that many toads which in the past had been identified as *B. regularis* are in fact *B. garnairi*. He is of the opinion that those referred to *B. regularis regularis* by Mertens (1955) are actually *B. garnairi*. Mertens himself states in 1955 that his specimens, which all are from South West Africa, differ from the typical species, but for lack of sufficient data on the regularis-group, he refers them to *B. regularis regularis*. In his 1971 work he considers them to be *B. garnairi pseudogarnairi*. It also has been shown convincingly by Channing (1972) that the characters of the South West African toads distinguished by Hudaichmann (1969) as *B. pseudogarnairi* fall within the limits of variation shown by *B. garnairi*. It would seem that *B. garnairi* is the most common toad in South West Africa (Channing and van Dijk, 1976), an assumption substantiated by my observations in the Etoha.

**Description:** Large toads reaching, according to Channing and van Dijk (1976), a length of almost 110 mm. My largest specimen, measuring 110 mm, was collected at Pan’s Edge. Dorsally the ground colour in *B. garnairi* is light brown which prior to moulting can become dark (Pienaar *et al.*, 1976); sometimes so dark that the dorsal markings become almost indiscernable (Peyton, 1964). These markings are dark brown or reddish-brown and bordered by an almost black lining. The larger patches are more or less symmetrically arranged, consisting usually of a medially divided interorbital bar, two smaller markings each adjacent to the anteromedial margin of the parotid gland, two large patches between the posterior portions of the
parotid glands, and two smaller ones in the mid-dorsal region. There are usually scarlet or red markings on
the thighs. Except occasionally for one or more small asymmetrical positioned spots, the area in front of
the inter-orbital bar is without markings, a feature
which among closely related forms is peculiar to
*Bufo garmani*. The underside is yellowish to white. In
some specimens the throat is dark grey to black.
Especially the sides and the upper surfaces of the legs
are very warty. The parotid glands are prominent.

**Habitat:** *Bufo garmani* is reasonably common in Etoша.
On one occasion at the end of November about half
dozens were found in the swimming pool at Halali,
some already dead since they could not get out.
Although this did not rain during this period, these toads
were heard calling at night at Halali and Goas. At
the latter locality calling coincided with the roar of
lions at the fountain. It was obvious that the roaring
of the lions triggered off the loud chorus which could
then be heard for a while only, after the roaring
of the lions had ceased. The presence of the lions made
any frog collecting unwise(), but a search the next
morning turned up a juvenile *Bufo garmani*, the choir
companions of the lions being already in their hiding
places.

Pienaar et al (1976) state that these frogs congregate
in large numbers around termite nests upon emergence
of flying termites.

**Breeding:** The existing literature does not provide any
information on the eggs of *Bufo garmani*. They are
probably laid in springs. Information on the tadpoles
too, is scarce. Wager (1965) considers them to be very
similar to that of *Bufo regularis*. This is in fact corroborated by van Dijk’s key (1971) to the Southern
African *Bufo* species, as well as the tadpoles which
I have collected at Halali at the end of November.
These were found in the swimming pool together with
adults of the same species. The very useful key of
van Dijk, based on tadpoles collected in Windhoek,
enabled me to identify the small Halali tadpoles of
about 15 mm.

Also at the end of November two small tadpoles were
collected at Groot Okavi. Overall lengths are 12 mm
and 13 mm including the stumps of the tails measuring
2 mm and 3 mm respectively. Although a tympanum is
still absent, they already show such features as the
tentral folds and the characteristic markings on the
dorsal surface of the head.

**Distribution:** The taxonomic confusion that existed and
partly still exists with regard to the Ethiopian bufonids,
renders it extremely difficult to ascertain the exact
spread of a form such as *Bufo garmani* which in the past
has often been referred to as *B. regularis*. It probably
inhabits the savannas of the greater part of Africa.
In South West Africa it seems to occur mainly in the
central and the northern areas which include the entire
Etoша. The Swakopmund (Puyton, 1964) and Goa-
nikoms (Mertens, 1955) specimens are probably

individuals washed down from the central highlands by
rains in the Swakop River. One could assume that
similarly a dispersal to the south along the Fish River
is highly probable.

5.2 **Bufo vertebrales hoeschtii** Abl

Mertens, Abh. stettenk. Naturf. Ges., 490:
25.

**Terra typica:** Kaiser Wilhelm Mountains, Okahandja.

**Type:** In the Zoologisches Museum, Berlin.

**Localities in Etosha:** Chudob Plain and the Old
Entrance Gate south of Namutoni.

**Localities elsewhere in S.W.A:** Eros Mountain, Ok-
ahandja and district, Onkomelana, Spitzkoppe
and Windhoek [Mertens, 1955; Puyton, 1964]; Chau-
son Mountain, Jakalskwater, Reebok and district
(Puy-
ton, 1964); Blutkopf, Kaiseb Bridge and Tsumaburg
(Channing, 1976); Albrechtshöhe (Karibib), Brak-
water, Brandberg, Causus Nord, Gubu, Gwishe
(Reeb-
both), Naukluf, Onposho, Otavi, Okjuungua, Oj-
semsa, Okahandja, Porisuth, Uvuvunjau, Warm-
quelle and Windhoek (specimens in Windhoek
Museum).

**Common names:** Pygmy Toad (Channing and van
Dijk, 1976); South West Pygmy Toad (author) on
the analogy of Transvaal Pygmy Toad for *B. vert-

**Taxonomy:** Puyton (1964) who has to date produced
the most authoritative work on the adult Southern
African bufonids, distinguishes the *vertebrales* group
of which Abl’s *B. hoeschtii* is a member under the new
combination of *B. vertebrales hoeschtii*. The differences
between some members of the *vertebrales* group are
so small and the diagnostic features so plastic, that
it is with great hesitation that I have identified my
specimens as *B. vertebrales hoeschtii*. Except for the lack
of a distinct tympanum they could as well have been
*B. vertebrales dondensus*. Obviously there is a great
need for an extensive taxonomic survey of the Pygmy
Toads belonging to the *vertebrales* group of Puyton.

**Description:** This is a small toad, reaching 40 mm
(Channing and van Dijk, 1976). Among my material
the one recorded from the Old Entrance Gate measures
26 mm, while the lengths of the Chudub specimens
vary from 29 mm to 31 mm.

The dorsal background colour is greyish to brownish
with irregularly shaped darker markings. These
markings are symmetrical, but somewhat indistinct.
A light occipital spot reaches anterolaterally to each
eye and is confluent with a narrow vertebral stripe
projecting posteriorly beyond a medially situated sacral
light patch. The occipital patch seems to be always
present. The vertebral stripes, on the other hand, is
absent in the material described by Marcens (1955) and in some of my specimens. The sacral patch is, is absent in some of my specimens, but all have a rather prominent light granular spot just antero-laterally to the base of the arm, below the parotid gland.

The underside is immaculate whitish, but breeding males have been found to be yellow under the throat (see Breeding).

My specimen from the Old Entrance Gate has distinct parotid glands. In the Chudob material these glands are rather flattened and somewhat indistinct. All specimens have concealed tympanums.

A tarsal fold is absent.

Habitat: Not much is known about these small toads. According to Channing and van Dijk (1976) they are often found in cracks in rock. My specimen from the Old Entrance Gate was collected by Mr Kalle du Preez in rather open sandy country, while the other specimens were found on the Chudob Plain. In April 1974 two were found in animal tracks in the already hard mud after the water of earlier rains had dried up. On a later occasion in January 1975 a thorough search at the same locality turned up nothing. The hard surface of the Chudob Plain was full of cracks and large clods of dry mud could be turned over, but even in this way not a single toad could be found.

That same night it rained and early the next morning there were literally hundreds of toads at the same spot, some calling from the water edge, others from positions in the shallow water near the edge.

One must come to the conclusion that these small toads withdraw deep into the cracks formed in the mud when the water dries up. In our search the previous day, we probably did not dig deep enough to find any.

Breeding: From the above it would seem that B. vertebralis hoeschi reacts strongly to rain. Among those calling, I found a pair in amplexus and upon picking them up, the male would not let go. They stayed in that position in a plastic bag for the rest of the day and the female even laid a string of eggs. The male, as well as others which had been seen calling, showed a yellow-coloured throat as compared to the rest of the whitish underside.

Development of eggs and tadpoles in B. vertebralis hoeschi has been observed by Channing (1976) in the Namib. He states that the eggs, which are laid in strings of about 400, develop into solitary bottom-dwelling tadpoles within 48 hours. It would seem that the tadpole stage is reached within 34 days.

Distribution: From the recorded localities it is evident that B. vertebralis hoeschi is probably restricted to South West Africa, being confined mainly to the central
and northern areas. Their presence in the Pre-Namib (Channing, 1976) however, indicates how well-adapted to life in arid regions they are and it might well be that this toad has a distribution much wider than that indicated by the recorded localities.

5.3 Breviceps adspersus adspersus Peters

1882 Breviceps adspersus Peters, Reise nach Mosambik, 3: 177.

Terra typica: Damaraland and Transvaal.

Types: In the Zoologisches Museum, Berlin.

Localities in Etosha: Okaukuejo and Otjovasandu.

Localities elsewhere in SWA: Nelspruit (Grootfontein), Okahandja and Okapemb (Okahandia) (Werner, 1915); Koko Olavi, Okahandja and Quiekenheu (Okahandia) (Mertens, 1955; Poynton 1964); Gobabis and Okahandja (Mertens) (specimens in Windbest Museum); Verena (Rehoboth) and Onjoka (Waterberg) (author).

Common names: Blaps and rain frog (Rose, 1950; Wager, 1965); Rehnpudda (Rose, 1930).

Taxonomy: B. adspersus adspersus is the only brevicarpit recorded from South West Africa. According to Poynton (1964) this species has often been confused with B. mossambicus Peters. Both Poynton (1964) and Mertens (1955) consider those brevicarpits recognised by Werner as B. mossambicus var. mossambicus (Werner, 1903) and B. mossambicus (Werner, 1915) to be B. adspersus adspersus.

Description: These are squat frogs with short, stubby legs. The females which are larger than the males, approach 60 mm (57 mm: Wager, 1965; 59 mm: Poynton, 1964). A specimen in my collection, collected at Okaukuejo by Mr Scotty Kyle, measures 62 mm from snout to vent.

There usually is a thin light vertebral stripe present, flanked by a series of more or less symmetrically placed whitish or yellowish to orange patches. The two in the scapular region are mostly somewhat elongated, while those in the mid-dorsal region are sometimes confluent. On each side another series of spots reaches from behind the eye backwards to the base of the hind leg. The space between all these lightly coloured markings,

Terra typica: Country to the east and north-east of the Cape Colony.

Types: British Museum, London.

Localities in Etosha: Namutoni.

Localities elsewhere in SWA: Ornhujomatamba near Waterberg (Mertens, 1951); Ongombe namibi 67 km north-west of Okahandja. Ojivianga (Mertens, 1971); Gumb (specimen in Windhock Museum; Ojivela (Channing, personal communication).

Common names: Red-hand frog (Wager, 1965; Channing and van Dijk, 1976); Pietha, Passmore and Carruthers, 1976; Roop-gelande of gomlastikpadde (Pietha et al., 1976).

Taxonomy: Noble (1926) believed that the African group arose from a different stock than the East Indian Phrynomantis. He therefore rejected the original name Phrynomantis bifasciatus given by Smith (1847) to the African form and subsequently proposed the name Phrynomerus, designating Phrynomerus bifasciatus (= P. bifasciatus) as the type-species. This name has since been accepted by almost all subsequent taxonomists.

Description: Phrynomerus bifasciatus attains a snout-vent length of 70 mm (Channing and van Dijk, 1976). The body posture is typically that of runners (crawlers) in contrast to the more upright posture of jumpers.

The colour of the dorsal surface is dark brown to black with two conspicuous reddish-orange to pink bands diverging from the snout, each running over the upper eyelid to the groin. The stripes can sometimes be interrupted, especially in the groin region. Apart from various patches on the legs, there is a characteristic triangular reddish marking on the sacral region.

The underside is greyish-brown, the males having a dark throat.

Habits: These frogs seldom jump, but usually walk or run. The fingers are expanded, forming discs which enable the frog to be a reasonably good climber. Mostly they shelter in or under decaying logs, under bark, in termite mounds, crevices and burrows. It seems, however, that they have a predilection for logs.

The skin exudes an excretion which is said to be fatal to other frogs (Rose, 1950).

Breeding: Males call from ground level (Pienaar, Passmore and Carruthers, 1976), sitting in shallow water or outside (Wager, 1965). Eggs have a diameter of 1.3 mm, each contained in a jelly capsule with a diameter of about 5 mm, and are laid in a mass of about 500 (Wager, 1965; Pienaar et al., 1976), 1000 to 1500 (Power, 1927). The mass is attached to vegetation floating just below the water surface, or it rests on the bottom in shallow water. The eggs hatch after four days and metamorphosis takes about a month.

Distribution: Phrynomerus bifasciatus occurs throughout the eastern parts of southern Africa, northwards to Kenya, and also in Angola and the eastern parts of Botswana. They seem to be very scarce in South West Africa, where their distribution appears to be limited to the north-eastern regions. The only one on record ever to be collected in Etosha is in the Windhuk Museum (S. M. R. 25077) and was found at Namutoni in May 1961 by Mr. B. de la Bat, the present Director of Nature Conservation and Tourism in South West Africa.

5.5 Phrynomerus annectens Werner


Terra typica: Aar River, near Aus, SWA. Type collected by Schultze in April 1904. Although Mertens (1955) considers the type locality to be in the Cape Colony, many vertebrate and invertebrate species collected by Schultze during the months March and April 1904 come from the farm Kubus in the Aus district, SWA. The map showing the routes followed by Schultze also shows Kubus, east of Lüderitz. The Aar River, however, is not indicated. Although not on Schultze's map, Kubus lies west of and adjacent to a farm named Aar, which without any doubt must be the type locality of Phrynomerus annectens.

Type: Poynton (1964) could not trace the 16 mm holotype described by Werner (1910), and nowhere does the literature available to me give a clear indication of its whereabouts. In his work on the amphibians and reptiles of South West Africa, Mertens (1955) states: "Der müs ich Nachprüfungen vorliegende Typus —" (p. 32), without, however, indicating where he obtained that "Typus", or listing it with the 55 specimens from the Senckenberg Museum, Frankfurt, examined by him. It must be noted that Mertens ascribes the term "Typus" to the type of a species-
group, i.e. the type-specimen, whereas, according to the International Code of Zoological Nomenclature, *Typus* and *typos* should refer to the type-species within a nominal genus. The explanation lies therein that the German translation of type is "Typus", spelt in the same way as the Latin synonym with a different application in nomenclature.

Certain deductions can be made from the existing literature, and if the holotype still exists, it would appear that the most probable places to find it might be Jena, where Schulze was a Professor, or Vienna, where Werner (1910) described and identified the amphibians and reptiles in Schulze’s collection.

Localities in Eushe: Equinus, Karossfonteine, Karossdrink, Okondessa, Ojoavandu, Otjovasandfonteine, Khoebendes, Karossponp and Stervalla.

Localities elsewhere in SWA: Krielkloof in the Great Karas Mountains (Metcalf and Hewitt, 1914); Okahandja (Ahl, 1934); Windhoek, Ongwediva near Omaruru, Spitzkoppe, Brandberg, Ojitambu in the Kaokoveld, Etosha, Otjiza, Tsho and Kalimbo (Mertens, 1955 and 1971); Santalas and Kowares (Inger, 1959); Namib Research Station (i.e. Gobabeb) and Sesfontein (Peyton, 1964); in the Namib at Blattekoppie, Tumasberg South, Auiga, Kuiemb Bridge and Mireibib (Channing, 1976); Brakwater, Kunene, Namus Valley, Portsmith and Wittershoet (specimens in the Windhoek Museum); Harlap and Mariental (author); Aar, district Aus (type locality).

Common names: Red-marbled frog (Channing and van Dijk, 1976); Komborspadkla (author, heard from children), Mariental, since its dorsal colouration resembles a crazy-quilt.

Taxonomy: There is no doubt that, as has been shown by Parker (1936), *Phrynomantis nasuta* of Metcalf and Hewitt (1914) and *Hoplophrynus marlorata* of Ahl (1934) are in fact *Phrynomantis annectens*.

Description: These are small, flat frogs with a characteristic colouration. Dorsally the ground colour is black, or greyish black, with several irregularly shaped reddish, pink, orange-like or yellowish patches of different sizes scattered over the back and the legs. Although there is no definite dorsal pattern, two paracloacal patches are nearly always present. The ventral sides of the body and the legs are an ashy white to grey, while the throat usually tends to be darker.

*Phrynomantis annectens* attains a snout to vent length of 40 mm (Channing and van Dijk, 1976). Among my collection a specimen from Otjovasandfonteine measures 38 mm.
Habitat: These are bushy and secretive animals which, when approached in the open, would rather run motionless for some time before suddenly running forwards or creeping sideways or even backwards to a hiding place.

Phrynopus annectens occurs in hilly areas where crevices, cracks and stones provide ample hiding place, and when dense enough, shelter against desiccation during dry times. The flat body enables them to make the ultimate use of deep, narrow crevices and cracks in which the temperature is even and the humidity relatively high. In the most comprehensive work up to date on these frogs, Channing (1976) states that during the day they remain in the shelter, only to come out after nightfall.

Phrynopus annectens is by no means a jumper. They always run or walk (creep). The toes are dilated into discs enabling them to climb very well, even against perpendicular glass.

Breeding: Although tadpoles were abundant at various localities, I came across eggs only once. These were attached to a twig drifiting in the drinking trough at Kassipump. Since the rain of the previous night (24/25 November) was the first for some time, it can be assumed that the eggs were laid that same night. I kept the eggs in a container for some time and the first free-swimming tadpoles appeared ca. 52 hours after the presumed deposit time. This does not agree with Channing's observations (1976) that the eggs of Phrynopus annectens in the Gobabeb region of the Namib hatch within 18 to 36 hours. The difference in hatching times can most probably be ascribed firstly to the unnatural conditions under which the eggs collected by me were hatched, and secondly to temperature differences of the water. Channing (1976) states that the water in which tadpoles were found in the Namib at times reached a maximum of 28°C.

Mating takes place after nightfall and amplexus is auxiliary (Channing, 1976). The gregarious tadpoles have an unusually broad head. Dorsally the colour is black, strikingly mottled with silver to gold. Metamorphosing stages and small froglets still have the motted appearance, but soon the adult pattern of colouration starts to appear, with the difference, however, that the patches are rather silver-greyish instead of reddish or pink in the adults.

On two occasions, i.e. January 1975 and again in March 1975, tadpoles, estimated to be several thousand, were found in the pools formed by the overflow around the reservoir at Kockoveld. They were congregated into large groups, each consisting of several hundreds of individuals.

Distribution: Phrynopus annectens can justly be designated a South West African frog. Although a few specimens have been collected in the south-west of Angola, inter alia from Morro de Puncio and Benguela (Parker, 1936), most other localities are from within South West Africa. Here they occur in the Kavango, the Khomas Hochland area, the Pre-Namib, Hardap and Mariental (most probably even further south along the Fish River) and the Great Karas Mountains. The type specimen comes from the farm Aar, distrikt Aus.

Within the Etosha Phrynopus annectens occurs only in the hilly western part. This agrees with the fact that they prefer hilly areas, and which of course means that also the Halali and the Ondodoroanamandana regions are feasible habitats.

5.6 Physcichalus adspersus Tschudi


1971 Rana (Physcichalus) adspersa (Tschudi), Merten, Die Herpetofauna Südst.-Afrikas, 17.

Turta typica: "Promonitoriun Bonae Spei" (Cape of Good Hope).


Localities in Etosha: Acacia, Adama, Andoni, Aus, Kameeldoring, Char Murris Dam, Fisher's Pan, Klein Okati, Leeuwen, Namutoni, Nauclo, Oktaras, Omojutjivi m'Bari, Pan 15, Pan 26, Stinkwater, Sprokieswoud, Sonderkop, Ofsnabud, Sterculia, Gansb, Gemsbokvlakte, Grieweul, Okondeka and Wolfeni.

Localities elsewhere in SWA: Nosoa, east of Rehoboth (Fleck, 1894). Okahandja (Ahl, 1934); between Lake Otjikoto and Nakusi, pan 120 km north of Namutoni, Ondangwa, between Ondangwa and Iota Dune, Iota Dune, Malakal (FitzSimons, 1938); Kusib River, Windhoek, between Auh and Klein Nauas, Ojoka (Mertens, 1953); 50 km west of Otjio, Oujo, Rehoboth, Omujoramabha, Onamungu, Klein Nauas (Poynton, 1964).

Common names: Generally known as bullfrog and brulpadda.

Taxonomy: Taxonomic work is at present being done on southern African bullfrogs. Until these studies are published, I am in no position to judge their status. For this reason the Etosha specimens are referred to as Physcichalus adspersus.
Description: Bullfrogs are well-known, easy to identify and need not be described here in detail. They are the largest frogs in Southern Africa, the males, which are larger than the females, reaching 200 mm from snout to vent. The largest specimen in my collection comes from the Stikwater road near the Auguneni Plains. It measures 185 mm.

The dorsal ground colour in adults is a dark olive-brown to grey, with a light vertebral stripe in most cases. In juveniles the colour varies considerably from a uniform light green to a green-brown, with a light green to yellow vertebral stripe almost always present.

Dorsally the most conspicuous characteristic is probably the broken longitudinal folds, usually up to 8 to 10 being present.

The underside has a yellowish-white colour while males also have a dark throat.

Habit: Large bullfrogs are scarce, probably since they are more prone to predators and also because, according to an estimate of Cairncross (1935), it takes a bullfrog 28 years to reach full size. On the other hand, during seasons in which the rainfall is high, thousands of young bullfrogs can be seen throughout Erosia, hopping in the veld seemingly in no definite direction kilometres away from the nearest water. In this way they easily fall prey to predators and probably only a small percentage will see the next season.

Bullfrogs are euryphages, eating everything that moves, even other bullfrogs. During their first year of existence fellow bullfrogs in large congregations probably constitute an important part of the diet because of availability.

The lower jaw has two prominent tooth-like projections, not only facilitating feeding, but also providing an effective defence weapon. Bullfrogs are aggressive and will even snap at humans.

They are well-adapted for digging, burrowing backwards. During the dry season they remain under ground, encapsulated in a thin cocoon, apparently leaving only the nares open.

Breeding: Eggs have a diameter of 2 mm, each encased in a jelly capsule with a diameter of 4 mm. Three to four thousand are deposited in shallow water and they hatch in two days. Tadpoles are gregarious and metamorphosis is completed after about 18 days.

Distribution: Bullfrogs are well-adapted to rich environments and are widely distributed throughout Southern and Central Africa. In South West Africa they appear to be absent from only the western (Namib) and the extreme southern parts.
57. *Tomopterna delalandei cryptopis*

Boulenger


**Terra typica**: Mossamedes, Angola.

**Localities in Etosha**: Acacia, Aasvoëlshad, Dolomietpunt, Dolomietpoort, Duineveld, Equitus, Jakkalswater, Karossdrink, Karossfontein, Karosspomp, Khoabendes, Klippan, Leehoven, Namiton, Okakuenje, Okondessa, Ojevasandu, Otjivasandufonteine, Otsjikji m'Bari, Pan 33, Pan 36, Renostervei, Sebrapomo, Sterculia, Stinkwater, Twee Palms and Von Lindequist Gate.

**Localities elsewhere in SWA**: Grootfontein, Okahandja, Omaruru, Tsutelshibach, Ojueleu near Neudamm, Rehoboth, Kuibis (Werner, 1915); Okahandja (Abl., 1934); Windhoek, Hoffnung, Omangorgua, Maltshibe (Parker, 1936); Itoms Dure, Kamajab (Fliszember, 1938); Keetmanshoop, Binsenheim, Nami near Rehoboth, Gammans, Windhoek, Okahandja, Ongombankavata, Gossikontes, Swakopmund, Spitzkoppe, Hartberg, Otjosembo, Kalidona (Mertens, 1955), Ovamboland, Sossfontein, Namib Research Station, Outjo, 120 km south of Gobabis, Great Karas Mountains.

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PLATE 7: *Tomopterna delalandei cryptopis.*


Taxonomy: In recent years the designation Tomopterna delalandei cryoptis has been preferred by most of the leading herpetologists in Southern Africa. The generic name *Pyxicephalus* was generally accepted until van Dijk (1966) pointed out that great differences between the tadpoles of *Pyxicephalus adspersus* and that of *Tomopterna (Pyxicephalus)* delalandei exist. Also the original specific name *delalandei* was quite rightly rejected by Poynton (1964) in favour of *delalandei* on the basis that the collector's name was Delalande. Recent preliminary work on the chromosome numbers of this group (Bogart and Tandy, 1976) indicates that a split into *Tomopterna cryoptis* and *T. delalandei* may be justified. However, a thorough study is required.

Description: *Tomopterna delalandei cryoptis* is a squat, heavily built, active jumper, reaching a snout to vent length of 51 mm. Dorsally the ground colour varies from an ash-grey to an olive-brown, occasionally even an orange-brown. Usually there are dark markings: in most cases an interorbital bar and several quite large patches scattered all over the back; no discernable pattern in some, but symmetrically arranged in others. A few ash-grey specimens were collected with no dark markings at all. In many cases a light vertebral stripe is present.

The underside is white, the males having a darker throat.

None of the Etosha specimens shows a tympanum. A prominent white ridge is present below the tympanic region and above the corner of the mouth.

Habits: These active frogs have a well-developed horny projection on the heel, with which they can dig rapidly into sandy ground. They usually appear in great numbers whenever it rains. In the laboratory aestivating *Tomopterna delalandei cryoptis* will "pop up like mushrooms" within 10 minutes from underground when water is sprinkled on the dry surface. As in *Pyxicephalus adspersus*, the availability of water in pools, fountains, etc. does not prevent them from digging in soon after the rains have stopped, apparently low humidity and/or pressures induce them to aestivate.

Breeding: During the breeding season they congregate in great numbers around standing water, the males producing a deafening chorus. Eggs have a diameter of 1.5 mm, the jelly capsules 3.0 mm. Between 2,000 and 3,000 eggs are deposited singly in shallow water, hatching within 3 days. The inactive tadpoles usually keep to the muddy bottom. Metamorphosis takes place within 5 weeks, after which the small froglets keep to the water's edge for some time.

Distribution: These are the commonest frogs of the drier parts of southern Africa, having a very wide distribution. In South West Africa they appear to be absent only from the Namib Desert, excluding the rivers flowing through it. In Etosha they are dispersed throughout the entire area.

5.8 Hildebrandia ornata Peters


1915 *Pyxicephalus ruddi* (Boulenger), Werner, Beiträge zur Kenntnis der Land- und Süsswasserfauna Deutsch-Südwestafrikas, 3: 374.


Type: Zoologisches Museum, Berlin.

Locality in Etosha: Ozenjiutji m'Bari.

Localities elsewhere in SWA: Nelias near Grootsfontein, Ombujomatenha near Waterberg.

Common names: Ornate frog (Wager, 1965; Pienaar et al. 1976); Ornate arrow frog (Channing and van Dijk, 1976); Sierlijke graspad (Pienaar et al. 1976).

Taxonomy: It would appear that apart from my Etosha specimen, only two specimens of *Hildebrandia ornata* have ever been recorded in South West Africa. Poynton (1964) convincingly shows that the Ombujomatenha specimen designated by Mertens (1955) as *Rana ornitssima*, is in fact *Hildebrandia ornata*. This is accepted by Mertens (1971) after re-examining the single specimen which is in the British Museum London.

The specimen from Nelias, Grootsfontein is described by Werner (1915) as *Pyxicephalus ruddi*. He states that the frog resembles Boulenger's (1907) *Rana ruddi* in all essential aspects. Already in 1911 Hewitt considered *Pyxicephalus ruddi* and *Rana ruddi* as synonyms which he suggested should be referred to as *Rana ornata*. Mertens (1955) too suspected Werner's *Pyxicephalus ruddi* to be *Rana ornatssima* (i.e. *Hildebrandia ornata*). In the meantime Poynton (1964) has shown that no distinction should be made.
between right and ornata. It thus can be accepted as *Hildebrandtia ruddii* from Nelsaas, Grootfontein (Wagner, 1925) as *Hildebrandtia ornata*.

**Description.** They are agile jumpers, reaching 65 mm long, and to vent; in general appearance, especially the colour, my specimen collected at Omenjutji m'Bari, resembled a young *Hildebrandtia aspersa* so closely, that while hopping around, among several young bullfrogs, I had been ignored at first.

The body is robust. The dorsal surface is light green, with some parts, however, tending to be rather a greyish-brown or even light brown. There are distinctly demarcated, irregularly shaped, brown to dark brown markings on the head, the legs, and the throat. These markings are more pronounced in males and females breeding in the southern parts of the species range. In *Hildebrandtia ornata* characteristically possesses continuous black bands running longitudinally on the forelimbs from the snout to a line between the front legs. This makes the frog very easy to identify.

**Breeding.** Males possess two vocal sacs, situated laterally. They produce a subdued blast-like call (Pianac et al., 1976). Eggs have a diameter of 1.4 mm and each is included in a jelly capsule with a diameter of 3 mm. They are laid singly in shallow water. Full size tadpoles already show the conspicuous bands on the throat.

**Distribution.** *Hildebrandtia ornata* occurs in the eastern parts of Africa, from Somalia in the north to Mozambique in the south. In central southern Africa the dispersal reaches westwards almost across the continent to southern Angola and northern South West Africa. The latter area probably represents the most southern dispersal limits in the western part of the continent and thus accounts for the scarcity of these frogs in South West Africa. Only three specimens, one from Omhunamatemba near Waterberg, another from Nelsaas near Grootfontein, and nine from Omenjutji m'Bari have ever been recorded from South West Africa.

5.9 *Cacosternum boettgeri* Boulenger


*Terra typica*: Kaffiraria.

*Types*: British Museum, London.

*Localities in Etosha*: Namutoni, Senderkop, Cacosternumpan (see map), Claudob Plain, ca. 5 km west of Duineveld, Fisher's Pan.

*Localities elsewhere in SWA*: Kraalooi, Sandennund and Naridas Suid in the Great Karas Mountains (Meinert and Hewitt, 1914); Omongoua near Okahandja (Ali, 1934); Hoffnung Farm, Maathoë, Vogoakra (Parker, 1936); between Ondonga and Itota Dunes (FitzSimons, 1938); Okahandja, Otjimbingwe, Rehoboth, Klein Naas, Neuhann (Mertens, 1955); Windhoek, Onibujumutama, 75 miles south of Gobabis, Otavi, Ounjo, Sesfontein, Kamanjab, Tsunkwe Pan (Poynton, 1964); Canum Nord, Okuwaongo, Gobabis, Otavi, Witterholt, Hardap, Hoases, Kaoko Otavi, Gaub, De Hoek (specimens in the Windhoek Museum).

*Common names*: Boettger's froglet (Channing and van Dijk, 1978); dainty frog, biksianertjie (Elenan, Passmore and Carruthers, 1976). Wagner (1963) refers to both *Cacosternum boettgeri* and *C. namus* as dainty frog.

*Taxonomy*: Apparently there are only two species of *Cacosternum* in South West Africa: *C. namaquense* in the extreme south, and *C. boettgeri* distributed over the entire area excluding the western part (Channing and van Dijk, 1976). Externally the former differs from the latter mainly in possessing larger dark spots on its belly. Although it is not easy to distinguish between the species in the *Cacosternum* group, *C. boettgeri*, apparently the only one to be found in the Etosha region, is readily recognizable among the Etosha frog by the dark spots on its belly. It must be stressed however, that within the *boettgeri* species, variability exists to such an extent that a taxonomic breaking up of the group may be warranted (Poynton, 1964).

*Description*: None of the frogs found in the Etosha region vary in colour to the extent found in *Cacosternum boettgeri*. Dorsally the ground colour can be different shades of green, grey or brown, with scattered dull brown to black markings. The latter are usually small.
and isolated, but in some cases they are, especially on the flanks, confluent, forming irregularly shaped patches, or sometimes longitudinal stripes. Many species have a yellowish vertebral stripe and in some there are lighter, but not distinctly demarcated, patches on the back. The ventral side is white with small dark grey to black spots of different sizes scattered on the belly, while the throat and thighs are sparsely mottled.

Due to the small size of the frog, the few inconspicuous smooth warts on the back, flanks and thighs are not easily seen. It would appear that the degree of wartiness varies considerably.

*Cacosternum bougeri* is Etosha's smallest frog. My largest specimen measures 24 mm and comes from the Chudob Plain. This size corresponds well with measurements recorded by several authors of specimens collected throughout southern Africa, viz. 21 mm (FitzSimons, 1935; Mertens, 1955); 22.5 mm (Poynton, 1964; Pienaar et al., 1976); 25 mm (Hewitt, 1911b; Chinnam and van Dijk, 1976) and 26 mm (Mathun and Hewitt, 1914).

**Habits:** These frogs have, like most anurans, but unlike e.g. *Breviceps* and *Pyxicephalus adspersus*, a partiality to water. Where pans and water-holes are devoid of dense vegetation, they can usually be found under stones and logs, or in cracks in the mud near the water's edge. In grassy vleis and around water-holes with dense vegetation, *Cacosternum bougeri* is due to its small size and its habit of withdrawing into hiding places underneath decaying plant matter covering the ground surface, extremely difficult to find.

Since this frog occurs in arid areas, some experts expect it to be a burrower. Mathun and Hewitt (1914) observed it to make holes of a few centimetres deep in soft mud, and also found specimens during dry conditions 30 to 40 cm deep in cracks in the ground. However, although Mathun and Hewitt consider these frogs to be burrowers, which they probably are to a very limited extent, their ability to survive arid conditions must rather be ascribed to the small size, allowing them to withdraw deep enough into cracks and crevices, or even holes of other animals, than to their presumed ability to dig.

The diet consists of small insects. According to Wager (1965) *Cacosternum nemum* seems to have a predilection for mosquitoes.

**Breeding:** During the rainy season the casuari-like call can be heard day and night. Eggs, in jelly capsules and with a diameter of 0.9 mm, are laid in clusters of 8 to 28 and are attached to suitable objects 2 to 8 cm
below the water surface. The tadpoles emerge within two days and the froglets may leave the water about 18 days after the eggs have been laid (Pieman, Passmore and Carruthers, 1976).

Distribution: Although Cacosternum hoettgeri has been collected from only about half a dozen localities in Etosha, these are spread over the whole of the area, from Namutoni in the east to the Duineveld area close to the western border. This, and since these frogs are presumably one of the commonest frogs in southern Africa, leads one to accept that they must occur throughout the entire Etosha.

5.10 Kassina senegalensis
Duméril & Bibron

1841 Cystignathus senegalensis Duméril and Bibron, Erpét. Gen., 8: 418.

Terra typica: Galam, Senegal.

Type: In the Muséum National d'Histoire Naturelle, Paris.

Localities in Etosha: Karossfontein, Okakuejo, Okotumare, Olianxbad.

Localities elsewhere in SWA: Gauscha, Hoffnung, Okahandja, Oshikango, Oshiwambo and Windhoek (Poynton, 1964); Klein Naukluft, Okombahe, Odongjibbe and Quickfontein (Mertens, 1955); Gau, Brakwater, Ombujomaterba and Oja-wana (specimen in Windhoek Museum); Okarukuvisa, Okatjikona, Okumerwa and Verona (author).


Taxonomy: Hoffman (1942) recognised the specimens collected by FitzSimons (1938) at Oshikango, Okavand, as K. senegalensis ovambensis on the basis of their pointed digital tips and the angular cartilaginous portion of the episternum. Both Mertens (1955) and Poynton (1964) express their uncertainty about the validity of Hoffman's subspecies. Poynton points out that Hoffman probably underestimated the degree of variation of these characters within the species. Without sufficient material available I would prefer to abstain from recognising my Okotumare specimen as K. senegalensis ovambensis on the grounds of its pointed digital tips and the somewhat angular cartilaginous part of the episternum.

With regard to other records of running frogs in South West Africa, it would seem that K. desertica collected at Windhoek and distinguished by All (1939) from K. senegalensis by reason of its granular ventral side, should be referred to the synonymy of the nominate form (Parker, 1936; Hoffman, 1942; Mertens, 1955; Poynton, 1964). Mertens (1971) considers desertica to be a subspecies of K. senegalensis.

Description: These are slender frogs attaining a maximum size of 52 mm (Poynton, 1964). The largest specimen in my collection measures 50 mm and comes from Okakuejo.

Dorsally the ground colour varies greatly. Usually it is a grey or golden olive, or even a pale grey. In some, however, it can be so dark that the dark dorsal markings are almost indistinguishable. These dark brown or blackish dorsal markings typically consist of three longitudinal stripes, sometimes flanked by two additional shorter stripes. It would seem that the latter two stripes are in most cases broken up into elongated markings. In some specimens even the two stripes flanking the vertebral stripe can be broken up. In all specimens collected a vertebral stripe was present. However, specimens collected by FitzSimons (1938) at Oshikango, Okavand, in May 1937 show only "longitudinal spots, not forming stripes, except occasionally an incipient vertebral one" (p. 207). Among my specimens the one collected at Okotumare, not far south of the Okavand border, approaches the Oshikango specimens the closest.

On the flanks and the upper surfaces of the legs are spots of varying shape.

The ventral side is yellowish, grey. Males possess prominent vocal sacs showing dark pigmentation.

Except in the Oshikango specimens of FitzSimons (1938) in which they are pointed (Hoffman, 1942), the tips of the fingers and the toes in running frogs are slightly swollen. My Okotumare specimen shows no swelling of the tips of the digits.

Habits: Adults are rarely found during daytime due to their habit of withdrawing deep into crevices, or to hide under stones or tussocks. At night during the rainy season they often congregate at the water's edge (Wager, 1965; Pieman et al., 1976). Such concentrations have not been observed in Etosha, probably because of scantily distributed populations. However, in the wet at Karossfontein three large numbers of K. senegalensis can be found any time of the day. They share the covered well of about 6 m deep with equally large numbers of Phenomenus amnesticus. Frogs of both species cling to the rocks just above water level and upon being approached, they retreat backwards into holes and crevices in the wall.

Running frogs are rarely seen to jump, even when disturbed. True to their common name they usually walk or run.

Breeding: According to Wager (1965) eggs of 1.5 mm in diameter are attached to waterplants, stones or sticks
150 to 300 mm below the water surface. The jelly-like layer swells to a diameter of 3,5 mm. The eggs are usually attached singly or in small groups of two or three, but not in great concentrations. They hatch in five to six days. Tadpoles grow up to 80 mm in length (Wager, 1965) and have the habit of hanging suspended head up in the water, only to escape at great speed when disturbed. They take about three months or longer to metamorphose.

**Distribution:** These frogs are well-adapted to life in arid regions and have one of the widest distributions among all Ethiopian frogs. They occur over the greater part of South Africa and Africa, reaching northwards as far as Egypt in the east and Senegal in the west. In South West Africa they seem to be absent in the north and the west, but are widely distributed over the northern and the central areas and should occur over the entire Etosha.

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