

# *Hyperolius argus* (Anura) in Natal: taxonomy, biogeography and conservation

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A high degree of variation in the colour pattern of *Hyperolius argus* Peters, including sexual dichromatism and a marked cline, has led to much taxonomic confusion. This East African species extends down the Natal coastal lowlands as far south as Durban. It has been assigned to *H. puncticulatus* (Pfeffer) in Natal. In a discussion of Mozambique and Natal material, this assignment is shown to be incorrect. The probable holotype of Cope's *cinctiventris* is considered to be a synonym of *argus*. There is some evidence that populations of *argus* intergrade with *semidiscus* Hewitt in Natal, and the occurrence of *semidiscus* on the periphery of the *argus* range is discussed in relation to the 'central-marginal' model of biogeographical patterning. It has not been possible to determine the relative vulnerability to habitat disturbance of *argus* compared to any other amphibian species, but the conservation prospects of this species at the southern end of its range currently seem extremely poor.

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'n Hoë graad van variasie in die kleurpatroon van *Hyperolius argus* Peters, insluitend seksuele dikromatisme en 'n karaktergradiënt het gelei tot taksonomiese verwarring. Die Oos-Afrikaanse spesie strek oor die Natalse kuslaaglande so ver suid as Durban en is toegewys aan *H. puncticulatus* (Pfeffer) in Natal. In 'n bespreking van die Mosambiekse en Natalse materiaal, word hierdie indeling as foutief bewys. Die moontlike holotipe van Cope se *cinctiventris* word beskou as 'n sinoniem van *argus*. Daar is bewys dat bevolkings van *argus* inskakel by *semidiscus* Hewitt in Natal en die verspreiding van *semidiscus* op die periferie van die *argus*-verspreidingsgebied word bespreek in verhouding tot die 'sentraal-marginale'-model van die biogeografiese patroon. Dit was nie moontlik om die relatiewe kwesbaarheid van *argus* jens habitatversteuring in vergelyking met enige ander amfibiese spesie te bepaal nie, maar die bewaringsmoontlikheid van hierdie spesie aan die suidelike punt van sy verspreidingsgebied, blyk tans uitsers swak te wees.

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*Hyperolius argus* Peters (1854) is a particularly large-sized species of reedfrog, with — as the species is presently understood — a large 'East African' range extending from Durban to southern Somalia (Lanza 1978) along the coastal lowlands. It shows an unusually high degree of variation in the colour pattern, including sexual dichromatism, which is further complicated by a marked north to south cline in the patterning. Not surprisingly, this has led to much taxonomic confusion.

In this paper, firstly the taxonomy is briefly reviewed for the purpose of validating the use of the name *argus* Peters for Natal material, which at the time of the last revision of Natal *Hyperolius* was assigned to *puncticulatus* Pfeffer (1893) (Poynton 1964). Secondly, this paper will discuss the biogeography and conservation of *H. argus* as a particular instance of an 'East African' species that reaches the southernmost limit of its range in the highly disturbed environment of Durban.

## The name *Hyperolius argus*

The high degree of polychromatism in both males and females of *H. argus* was described and illustrated by Parker (1930), who studied the large series collected by Cott (1932) in the lower Zambezi, not far from the type locality of the species (Boror, approx. 1736 C). Parker showed that adult males retain the juvenile colouration and markings, presenting a dark canthal line, darkening on the upper eyelid, and, occasionally, dark stippling over the dorsum. A light dorsolateral stripe is usually evident, tending to pass forwards over the upper eyelid along the canthus rostralis. The upper surfaces were described as being green in life, and the dorsolateral stripe golden. The adult females were shown by Parker to develop a quite different pattern, consisting of a broader light canthal band which extends over the upper eyelid to form a pair of incomplete 'spectacles'. Light markings are present over the dorsal surface as spots to irregular bands. The ground colour in life was stated to be brown to purple.

In Natal, while the adult male patterning described by Parker may occasionally occur (e.g. Passmore & Carruthers 1979: 246), the great majority of males have a brown ground colour, sometimes with darker speckling, and with a usually heavy dark bordering to the light dorsolateral bands (Poynton 1964 fig. 109, Passmore & Carruthers: 246). This pattern is not described in Parker's Zambezi material, and it strongly recalls the pattern of *puncticulatus*. Females collected in Natal hardly ever show the 'typical' light dorsal ocelli or spots of *argus*: at most there are only dorsolateral bands or spots.

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This southern material was consequently assigned to *puncticulatus* (Poynton 1964).

Material subsequently collected mainly by Broadley in southern Mozambique and the eastern lowlands of Zimbabwe showed variation which appeared to include both Zambezi and Natal patterns. Some of this material (then housed in the Umtali Museum) was sent to Dr. A. Schiøtz for examination. Two males from Marhumbini were identified as *puncticulatus* (Schiøtz 1975), while the remainder were returned with uncertainty as to whether they were *puncticulatus* or *argus*. The range of variation among the males of this material includes the *argus* pattern described by Parker, through specimens in which the dark speckling becomes denser above and below the light dorsolateral bands, producing at the extreme the dark-bordered '*puncticulatus*' pattern which predominates in Natal material. The range of variation in females also includes the *argus* pattern described by Parker, with dorsal ocelli, through the specimens in which the light markings behind the head become reduced and confined to dorsolateral bands or spots, to specimens only with 'spectacles' (Figure 1). The ocellated variant becomes increasingly rare to the south.



**Figure 1** Variation in specimens from a collection of *Hyperolius argus* from Dondo, near Beira, Mozambique (material in the Natural History Museum, Bulawayo, collected December 1969). Natural size. Top: males (UM 22081 & 21985). Bottom: females (UM 21993, 21997 & 21998). Specimens 21985 and 21998 represent the predominant male and female patterns in Natal.

The Natal material may therefore be seen as the extreme in a cline, with the southern establishment of a heavily bordered dorsolateral band in the male and loss of post-cephalic markings in the female. This tendency is consistent with the cline previously noted in material occurring north of the Zambezi (Poynton 1964; Schiøtz 1975): Kenyan females show intense spotting of the back and also the legs. These light markings are made even more conspicuous by being

white. Southwards, the spots become increasingly yellow, reduced in size and number, and south of about the Save River (21°S) the leg spotting seems to disappear altogether.

It therefore seems reasonable to treat all this material as a single species with a cline extending all the way along the eastern coastal lowlands. Even in Natal, where males tend to resemble *puncticulatus*, the material cannot correctly be called *puncticulatus* because sexual dichromatism is shown, which is not a feature of *puncticulatus*. This was overlooked by Poynton (1964) and Schiøtz (1975). Moreover, Natal females, even when lacking light spots as in *puncticulatus*, have no extension of the canthal upper-eyelid band behind the eyes, which is a characteristic of *puncticulatus*. This re-evaluation therefore leaves *puncticulatus* Pfeffer as a species with known southern limits in upland areas of Malawi, and not in Mozambique or Natal.

An opportunity, in 1984, to examine Cope's Natal *Hyperolius* material in the Academy of Natural Sciences, Philadelphia, made it apparent that the specimen presumed by Loveridge (1941) to be the type of *cinctiventris* Cope (1862) (ANSP 11322) is a specimen of *argus* Peters (1854). Although faded, this specimen from Umvoti shows a distinct pair of dark lines arising between the nostrils, then each line diverging to run along the canthus to a dark patch on the upper eyelid. This is a characteristic feature of immature *argus*: the markings on the presumed *cinctiventris* type in fact agree exactly with Parker's somewhat faded British Museum material of immature males and females. As Loveridge (1941) noted, there are indications of a somewhat diffuse light stripe running above the dark canthal line and continuing to two thirds of the way down the body: this is similar to the patterning of the green Richards Bay specimen of *argus* illustrated by Passmore & Carruthers (1979: 246).

Loveridge (1941) placed *H. semidiscus* Hewitt (1927) in the synonymy of *cinctiventris*, but *semidiscus* lacks the *cinctiventris/argus* dark canthal line, and the *cinctiventris* type lacks the very conspicuous light dorsolateral band of *semidiscus*. Loveridge did however note that the affinities of *semidiscus* appear to lie with *argus* and *puncticulatus*, and the relationship between *semidiscus* and *argus* in Natal deserves further study. Wager (1965) found the eggs and tadpoles of these two species to be indistinguishable, but the calls are conspicuously different (Passmore & Carruthers 1979). *H. argus* occurs on the coastal lowlands as far south as Durban, while *semidiscus* occupies a belt commencing slightly inland. Two Natal Museum specimens from Eshowe (NM 5744), a female with *semidiscus* markings and a male with heavy dark bordering to the dorsolateral band, more typical of *argus* than of *semidiscus*, provide evidence that the two species could be sympatric; but more material is needed to establish whether intergrading does or does not occur there. Eight Natal Museum males collected from Mount Edgecombe (NM 4117–4118, 4137–4139, 4140–4142), just north of Durban, mostly show the typical Natal *argus* pattern, but in one there is light spotting on the legs, a feature of *semidiscus*, and in another the dorsolateral bands are narrow and have a very fine dark edging, which recalls *semidiscus* markings. Hybridization is suggested by this series, but, as is recorded in the next section of this paper, this population is now extinct.

It is worth noting that the reduction of variation in southern populations of *argus*, and the presence of *semidiscus* at the periphery of the *argus* range, appear to fit the 'central-marginal model', recently reviewed by Brussard (1984). The model holds that populations on the margin of a range are isolated, sparse, chromosomally monomorphic, and play a

leading role in speciation events (Brussard 1984). The taxonomic situation regarding *argus* and the peripheral *semidiscus* seems worth studying in the light of this model. A particular ecological aspect of the model will be taken up in the next section of this paper.

### The status of *H. argus* in the Durban area

Brussard (1984) recently pointed out that the periphery of the geographical range of a species need not necessarily be marginal with respect to ecological circumstances. It is, nevertheless, generally assumed to be the rule that environmental stress is maximum at the periphery of a range, especially the range of a widespread species, and the distribution of *H. argus* is probably no exception. Habitat disturbance accompanying human settlement could be expected in most cases to compound the environmental stress at the periphery of a range. The results to date of a survey conducted to investigate the situation regarding *argus* are, however, even more negative than had been anticipated.

The floating leaves of water lilies (*Nymphaea*) form the calling and retreating site of males. This lily-pond habitat is considerably at risk in any settled area. The southernmost known population of *argus* occurs in a typical lily pond in the Stainbank Nature Reserve in southern Durban (29°53'S), controlled by the Natal Parks Board. No other populations are known in Durban. A population sampled in 1958 at Mount Edgecombe, just north of Durban (29°42'30"S), has disappeared, evidently owing to habitat destruction. This was the population showing features suggesting intergrading with *H. semidiscus*, discussed earlier. In 1979, a large population of typical *argus* was flourishing 0°05' north of Mount Edgecombe in a lily pond in the grounds of a seaside estate, Shalimar Gardens; but following new ownership the ponds in the estate have become overgrown and filled in, and the *argus* population is now probably at extinction point. The species has been searched for in the Tongaat-Compensation area (as far north as 29°31'S), so far without success.

Water lilies occur in several ponds in the Durban-Compensation area, apparently providing suitable habitat for *argus*. The absence of *argus* from such lily ponds is difficult to interpret on account of the possibility of previous habitat disturbance in presently normal-looking ponds. An instructive example of such a possibility is given by a pair of interlinked dams near Compensation (farm Redwoods). The dams at one time supported the southernmost recorded population of the widespread East African hyperoliid, *Kassina maculata* (Wager 1965). *K. maculata* also favours ponds with water lilies, and lilies are indeed currently present in the dams, but not *K. maculata*, or *H. argus*. Investigation showed that some 25 years ago, red-breasted bream (*Tilapia melanopleura*) was introduced into the two dams. These fish almost totally destroyed the water lilies, which led, among other things, to the disappearance of jacanas (*Actophilornis africanus*). To control the bream, the upper dam was poisoned and the lower dam drained. This treatment did not wholly eliminate the bream, so bass (*Micropterus salmoides*) were introduced. Being an 'avid predator' (Jubb 1967: 187), it is likely that the bass destroyed tadpoles of any *K. maculata* that had survived the first treatment. The bass have however kept the bream in check, so the aquatic vegetation is returning to what appears to be, at first sight, an undisturbed state.

It may not safely be assumed that any body of water in the Durban area is undisturbed, even if there is presently a good stand of water lilies. Several such ponds exist, and most carry populations of *Hyperolius pusillus*, a species whose

males also call from lily pads; in fact antiphonal calling between *argus* and *pusillus* males is not uncommon. Yet the small-sized *pusillus* seems biogeographically more robust than *argus*, judging from the much wider geographical range of *pusillus* both westwards and southwards, so its presence in a pond need not be an indicator that *argus* necessarily at one time occurred there as well. Beyond this consideration, though, the vulnerability of *argus* populations compared with those of *pusillus* or any other species is unknown. And the opportunity for the study particularly of any range-periphery effects in *argus* at the southern extreme of its range now seems to be lost.

A disaster of this kind shows the necessity of coming to grips with an area of study that the zoological community has tended to treat with some aloofness, namely urban biogeography. Habitat destruction accompanying urban development tends to proceed with unimagined speed, yet there is evidence that much can still be saved by effective contact between biologists and civic authorities (Poynton & Roberts 1985). It is hoped that a herpetological survey of Durban, being carried out by the Department of Biological Sciences of Natal University with much cooperation from the Durban Corporation (Poynton 1985), will help to avert further disasters of the *H. argus* type. In Durban the conservation situation is particularly critical owing to the city's location in the transition zone that exists between tropical and non-tropical groups of animals and plants (Poynton 1961).

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