

The Threatened, Exploding Frogs of the Paraguayan Dry Chaco



Fig. 1. The aposematic colouration of the Chaco endemic Coralline frog *Leptodactylus laticeps* (Leptodactylidae) warns of the toxic skin secretions it produces. Photo: Paul Smith.

By P. Smith¹

"We were compelled to dig again and again, until we had dug thirteen wells before we found potable water... Everybody wants to leave, for we're all dying here. The heat is unbearable... ; if you still have enough potatoes for a meal, thank God for it, ... here there aren't any"

Anonymous Mennonite settler in the Paraguayan Chaco (quoted in 1)

Paraguay, situated at the heart of the megadiverse continent of South America, is divided into two geologically distinct regions by the great Paraguay river; to the east the densely-populated Orient, and to the west the remote, desolate Chaco. The Chaco is as diverse as it is vast and can be separated broadly into three sections, the marshy palm savannas of the Humid Chaco of Presidente Hayes department, the lush Pantanal and Cerrados of Alto Paraguay department and the arid, thorny, scrub forests of the Dry Chaco of Boquerón department.

Conditions are most extreme in the Dry Chaco where daytime temperatures exceed 40°C in summer, occasionally dip below freezing in winter and annual rainfall may be as low as 35cm per year (2). Despite this a total of 36 amphibian species call this inhospitable wilderness home (3), a remarkable number of water-dependent am-

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phibians for one of the driest regions on earth.

Such extreme conditions breed extreme life strategies, and the frog fauna of the Dry Chaco is one of the most unique and highly-adapted in the world. Many species spend much of the year underground in cool, moist burrows to protect themselves from desiccation, whilst others can persist only because of the presence of artificial but permanent water sources in the form of *tajamares* (cattle ponds). Most species however, depend exclusively on the short, but torrential rainy season (October to November), when an explosion of anuran activity occurs, as myriad species clamor to feed and breed in the brief window when temporary pools of precious water gather on the compacted clay soil surface. On wet nights a cacophony of frog song fills the air, and the ground writhes with a million hopping shadows as individuals of multiple species hurriedly take advantage of that rare commodity – fresh water.

With time of the essence and the breed or feed dilemma high on the agenda, several large frogs have evolved into specialist frog predators, maximizing their foraging efficiency by feeding on their smaller neighbors, victims that are hopelessly constrained by their need to frequent the same water holes as their hunters (4). But there are many ways to catch a frog. The Coralline frog *Leptodactylus laticeps* (Fig. 1), a huge and wonderfully-colored endemic has been hypothesized to imitate the call of its main prey, the abundant Oven frog *L. bufonius* in order to attract it close enough for the kill (5). Five species of Ceratophryidae have massive heads and a wide gape



Fig. 2. Budgett's frog *Lepidobatrachus laevis* (Ceratophryidae) is a grotesque, subaquatic predator. Photo: Paul Smith.



Fig. 3. Colloquially known as the Pacman frog because of its huge gape, Cranwell's horned frog *Ceratophrys cranwelli* (Ceratophryidae) here performs its stiff-legged defensive display, a prelude to bites and hisses. Photo: Paul Smith.



Fig. 4. Mueller's narrow-mouthed frog *Dermatonotus muelleri* is the largest and most distinctive of the Paraguayan Microhylidae. Photo: Paul Smith.

lined with maxillary teeth, ideal for catching and holding on to slippery, anuran prey. The Jabba-the-Hut like aquatic genus *Lepidobatrachus* (Fig. 2) with their beady, dorsally-located eyes and large, webbed hind feet are submarine hunters striking at unsuspecting

victims from below the water surface (4); and the grotesquely-beautiful Cranwell's horned frog *Ceratophrys cranwelli* (Fig. 3) has such a huge head compared to the body that it has earned itself the nickname the Pacman frog.

With such diverse and ingenious threats lurking behind every



Fig. 5. A mating pair of Earless leaf frogs *Phyllomedusa azurea* (Hyllidae). Photo: Paul Smith.

clod of mud, equally diverse and ingenious defenses have also evolved to combat them. Aposematic coloration, warning of toxic skin secretions has created some extraordinarily handsome creatures such as Mueller's narrow-mouthed frog *Dermatonotus muelleri* (Fig. 4) and the Earless leaf frog *Phyllomedusa azurea* (Fig. 5) (4), whilst the abundant, small and otherwise virtually defenceless Four-eyed weeping frog *Physalaemus biligonijerus* may rear up its hind legs, elevating its rump where it hopes that large black blotches on the inguinal glands resemble the eyes of a larger animal rather than the backside of a small one. Even the Ceratophryids, top of the amphibian food chain, possess their own intimidating defense displays, standing tall on rigid legs and jumping, biting and hissing at the threat (regardless of size). Less physically imposing, the smallest member of the family, the Lesser Chini frog *Chacophrys pierotti* (Fig. 6), blows itself up like a ping-pong ball to make it harder to swallow, but throws in a few bites for good measure.

Breeding strategies are equally varied as feeding and defense strategies. Frogs of the families Leptodactylidae and Leuiperidae, construct floating foam nests by rubbing their hind legs together, utilizing even roadside puddles for the purpose, and buying the eggs a short stay of execution before the next rains should their pond rapidly dry out (6). The highly aquatic, oar-footed, La Plata paradox frog *Pseudis platensis* (Fig. 8) has a tadpole twice the length of the adult that shows hardly any growth following metamorphosis (7), and Sauvage's leaf frog *Phyllomedusa sauvagii* constructs a nest of leaves overhanging water in which to deposit its eggs, coating them in a strange jelly-like substance which can modify its structure according to degree of hydration (8).

The remoteness and inaccessibility of the Dry Chaco meant that this marvelous ensemble of charismatic amphibians was virtually unknown until the turn of the 20th Century (9) and until very recently the opportunity to experience it first hand was a luxury of an adventurous and occasionally foolhardy few. The completion of the Trans Chaco Road in the 1960s made the region accessible

for the first time, opening up the area up to herpetologists who leapt at the chance to begin to document the complex ecologies of these mysterious animals. However, improved access also brought with it accelerating development and habitat destruction, a process which has now reached crisis proportions in the Paraguayan Chaco. Land conversion rates in the Paraguayan Chaco continue to be amongst the highest in South America (10) and it has been estimated that at the current rate of deforestation all suitable land not currently in the protected areas system will have been converted into ranchland by 2025 (11).

This is seriously bad news for the nine Chaco amphibian endemics that occur in Paraguay, all of which will now have to deal with rapid changes to an environment which they have spent millennia adapting to. Deforestation, over-grazing, desertification, salinification of soils and collection of ground water for irrigation are all hallmarks of an increasing human presence in this delicate environment (12, 13), while the use of agrochemicals and the newly legalized collection of live animals for the pet trade (14) will all present new challenges that this extraordinary frog fauna must rapidly learn to navigate.

The future may be uncertain for the Chaco, but with a frog fauna adapted to triumphing in the face of adversity, we can only hope that this is just another obstacle to be overcome in their eternal battle for survival.

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References

1. P. P. Klassen, Die Mennoniten in Paraguay: Reich Gottes und reich dieser welt, (Mennonitischer Geschichtsvereine, Bolanden-Weierhof, Germany, 2001), vol. 1, 2nd ed.
2. F. Hayes, *Am. Bird. Assoc. Mon.* 1, 1 (1995).
3. F. Brusquetti, E. O. Lavilla, *Cuad. Herp.* 20, 3 (2006).
4. N. J. Scott, L. A. Aquino, in: *Ecology and Evolution in the Tropics: A Herpetological Perspective*, Donnelly *et al.*, Eds. (University of Chicago Press, Chicago & London, 2005) pp. 243-259.
5. R. Heyer, N. J. Scott, *Herp. Nat. Hist.* 9, 189 (2006).
6. R. Heyer, *Evol.* 23, 421 (1969).
7. M. Fabrezi, S. I. Quinzio, J. Goldberg, *J. Herp.* 43, 228 (2009).
8. A. P. Alcaide, M. F. Alcaide, F. J. P. Alcaide, E. O. Lavilla, *South Am. J. Herp.* 6, 20 (2011).
9. J. S. Budgett, *Quart. J. Microscop. Sci.* 42, 305 (1899).
10. R. Cardozo, F. Palacios, O. Rodas, A. Yanosky, *Paraquaria Nat.* 1 (2), 43 (2013).
11. A. Yanosky, *Paraquaria Nat.* 1 (1): 32 (2013).
12. J. Schofield, E. H. Bucher, *Trends Ecol. Evol.* 1: 78 (1986).
13. E. H. Bucher, P. C. Huszar, *J. Env. Man.* 57, 99 (1999).
14. T. Vinke, S. Vinke, *Schildkröten im Focus* 2: 1 (2012).



Fig. 6. A Lesser Chini frog *Chacophrys pierotii* (Ceratophryidae) begins to inflate itself, to protect against predation. Photo: Paul Smith.



Fig. 7. The gigantic Rococo toad *Rhinella schneideri* (Bufonidae), which can reach 30cm in length, cools off in a muddy puddle. Photo: Paul Smith.



Fig. 8. The oversized, oar-like hindfeet of the La Plata paradox frog *Pseudis platensis* (Hylidae) are an adaptation for a largely aquatic existence. Photo: Paul Smith.