Crypsis in two species of tinamou (Tinamiformes: Tinamidae): roosting Solitary Tinamous [*Tinamus solitarius* (Vieillot, 1819)] probably mimic owls

Crípse em duas espécies de Tinamidae (Tinamiformes: Tinamidae): macucos [*Tinamus solitarius* (Vieillot, 1819)] repousando em galhos provavelmente imitam corujas

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Abstract: Observations of defensive behaviours in two species of tinamous are described. Use of the subcaudal feathers as a means of nest crypsis is described and illustrated in an incubating Tataupa Tinamou (*Crypturellus tataupa* (Temminck, 1815)). An arboreal roosting Solitary Tinamou [*Tinamus solitarius* (Vieillot, 1819)] is shown to deliberately assume a tail up posture indicating Batesian mimicry of a large owl. It is hypothesised that the imbricated scales on the posterior tarsi of this species assist in assuming this posture, and that such a defence is necessary given the exposed perches on which they choose to roost and the notoriously poor flight capacity of members of this family.

Keywords: Batesian mimicry. *Crypturellus tataupa*. Nest defence. Paraguay. Tataupa Tinamou.

Resumo: Observações do comportamento defensivo de duas espécies de Tinamidae foram descritas. É descrito e ilustrado o uso de penas subcaudais como mecanismo de crípse do ninho por um espécime de inhambu-chintã (*Crypturellus tataupa* (Temminck, 1815)), que estava encubando os ovos. Também foi registrado um espécime de macuco [*Tinamus solitarius* (Vieillot, 1819)] que estava empoleirado no galho de uma árvore e, quando perturbado, ergueu a cauda, assumindo a aparência de uma coruja, possivelmente um exemplo de mimetismo Batesiano. Supõe-se que as escamas imbricadas da parte posterior do tarso ajudam a assumir essa posição e que essa defesa é necessária, já que aves desta família repousam durante a noite em galhos expostos e possuem capacidade de voo limitada.

Palavras-chave: Mimetismo Batesiano. *Crypturellus tataupa*. Defesa do ninho. Paraguai. Inhambu-chintã.

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The tinamous (Tinamidae) are a family of primitive, terrestrial gamebirds endemic to Central and South America (Davies, 2002). They are typically shy, inconspicuous and with cryptic plumage, and occur in a variety of grassland and forested habitats from sea level to the almost 5,000 m in the high Andes (Fjeldsa & Krabbe, 1990). Twelve species of tinamou in seven genera occur in Paraguay (Guyra Paraguay, 2004).

Many species in the genera *Tinamus* and *Crypturellus*, have the 'tail', belly and subcaudal plumage intricately patterned with cryptic, marbled feathers (Davies, 2002). Though startled birds generally sneak away through undergrowth, crouch or suddenly burst into flight, birds that are unable to do so (*e.g*. when nesting or roosting), will commonly raise the tail end, pushing the head downwards and fan the subcaudal and belly feathers in a form of cryptic defence. Similar behaviours have also been reported during courtship where it is assumed that they give an inflated impression of the size of the bird (Sick, 1993) or provide visual cues analogous to similar displays seen in pheasants (Phasianidae) (Davidson, 1976).

In this paper we describe two observations of cryptic behaviours in two species of forest tinamou from Paraguay: Tataupa Tinamou *Crypturellus tataupa* (Temminck, 1815) and Solitary Tinamou *Tinamus solitarius* (Vieillot, 1819).

TATAUPA TINAMOU *CRYPTURELLUS TATAUPA* CRYPSIS AT THE NEST

Tataupa Tinamou *Crypturellus tataupa* is one of the commonest forest tinamous in Paraguay, occurring throughout the country in both humid and dry habitats (Guyra Paraguay, 2005). A nesting Tataupa Tinamou at Pro Cosara, Parque Nacional San Rafael, Itapúa department during February 2008 was observed by PS to adopt a cryptic pose whilst sitting on five eggs on a nest (Figures 1 and 2) exposed in leaf litter at the edge of a bamboo thicket. Though the sitting bird allowed a close approach to less than a metre, the defensive intention of the behaviour was confirmed by the bird slowly rotating the body as the observer changed direction, thereby ensuring that the tail end was continually in view.

Figure 1. Incubating male Tataupa Tinamou at Pro Cosara, Parque Nacional San Rafael, Itapúa department, Paraguay. Photo: Pro Cosara (26 February 2008).

Figure 2. Same bird as Figure 1 adopting cryptic posture upon approach of the observer. Photo: Pro Cosara (26 February 2008).

Tinamou eggs are well-known for being conspicuous, brightly-coloured, with a 'porcelain' appearance, and they are typically large when compared to the size of the adult (Sick, 1993). Such defensive behaviours, which involve considerable risk to the sitting male, may have evolved because of the high energetic investment made by both sexes in reproduction, coupled with the obvious vulnerability of conspicuous eggs in ground nests.

The same Tataupa Tinamou was seen to carefully cover the eggs with vegetation when leaving them unattended, a protective behaviour observed in other species of the genus (Schwartz & Lentino, 1984). Additionally, Sick (1993) mentioned injury feigning in an individual of this species that was startled at a nest, but this was not observed in the Paraguayan individual which, when approached too closely, crept slowly away into nearby undergrowth with the head held close to the ground.

SOLITARY TINAMOU *TINAMUS SOLITARIUS* PROBABLE OWL MIMICRY

The Solitary Tinamou *Tinamus solitarius*, one of the largest members of the family, is an Atlantic Forest endemic occurring in eastern and central Brazil, eastern Paraguay and northeastern Argentina (Cabot, 1992). It is an arboreal rooster, choosing horizontal branches in the subcanopy. They go to roost noisily, resting on their tarsi which are hardened on the posterior side and covered with imbricated scales which enable the bird to maintain a grip without using the feet (Sick, 1993). Imbricated scales are absent in the congeneric Great Grey Tinamou *Tinamus tao* Temminck, 1815 which only occasionally roosts arboreally, and when it does, does so on a bed of branches rather than on a single branch (Sick, 1993).

The typical roosting pose of Solitary Tinamou is upright with the head drawn into the shoulders (Figure 3). However on two occasions at the Reserva Bosque Mbaracayú, Canindeyú department during August 2014 (PS) and October 2015 (PS and PM), when roosting birds were approached at night, they adopted a head down-tail up pose with ventral feathers fanned which, when viewed from behind, was strikingly owl-like in both form and appearance. Batesian mimicry occurs when an inoffensive species evolves to imitate a harmful or noxious species or species group in order to deter predation. There would seem little doubt that this is a form of Batesian mimicry as on each occasion the bird deliberately turned to present its rear end to the observers (Figures 3-5), and was

Figure 3. Roosting adult Solitary Tinamou at Reserva Bosque Mbaracayú, Canindeyú department, Paraguay. Photo: Pete Morris (October 2015).

Figure 4. Same bird as Figure 3 deliberately turning away from the observers. Photo: Pete Morris (October 2015).

Figure 5. Same bird as Figures 3-4 adopting the tail up posture showing Batesian mimicry of a large owl. Photo: Pete Morris (October 2015).

immediately and independently identified as a large owl by observers on both occasions until it could be observed more closely.

The ventral plumage of tinamous does not itself resemble foliage, though the complex, cryptic patterns can act to break up the birds outline in densely-vegetated areas. Regardless, imitating foliage whilst roosting on exposed branches would seem a rather convoluted and unnecessary defensive strategy, less effective as an anti-predation method than simply roosting within foliage. The evolution of the imbricated scales on the posterior tarsi of *Tinamus* tinamous indicates strong selective pressure for arboreal roosting and this highly-developed gripping system is presumably also necessary in order for the bird to assume this delicately-balanced tail up posture whilst perched.

Though arboreal roosting in *Tinamus* may be interpreted as an attempt to avoid nocturnal terrestrial predators, the exposed perches that the birds chose leave them vulnerable to nocturnal arboreal predators. Tinamous are famously weak fliers, their initial burst of powerful flight being noisy and sustainable for only a short distance due to a small heart (0.19-0.25 % of total body weight) providing insufficient blood flow to the well-developed pectoral muscles (Davies, 2002). Sick (1993, p. 96) comments on how Solitary Tinamous reach the roosting branches noisily and clumsily "taking off almost vertically in a previously chosen trajectory that must be completely free of obstacles".

Noisy take off, a physiological inability to sustain flight and a lack of manoeuvrability once airborne means that the typical tinamou defence of suddenly bursting into flight upon the close approach of a potential nocturnal predator becomes extremely risky for an arboreal roosting bird at night. The loud wing noise would draw considerable attention, the risk of collision with branches in the dark is extremely high and the low flight capacity would provide only limited distance between the bird and the predator. Indeed, under such circumstances the evolution of further mechanisms that discourage close approach by a predator, such as the proposed Batesian mimicry in this case, would seem a logical and important way to avoid this potentially dangerous scenario.

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