

## A green-shouldered variant of the Turquoise-fronted Amazon *Amazona aestiva* from the Sierra de Santa Bárbara, north-west Argentina

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Received 29 September 2005; final revision accepted 3 July 2006  
Cotinga 27 (2007): 71–73

El Loro Hablador *Amazona aestiva* comprende dos subespecies: la subespecie *aestiva* (en el noreste de su distribución; de hombros rojos) y la subespecie *xanthopteryx* (en el suroeste de su distribución; de hombros amarillos con marcas rojas). En este trabajo describo una nueva variante de Loro Hablador, proveniente del oeste del Complejo de la Sierra de Santa Bárbara (CSB) en el noroeste de Argentina, y que carece de amarillo en la cara y que posee los hombros verdes. Mientras que una población al oeste del CSB muestra una variación mayor a la esperada, con individuos de hombros verdes, individuos intermedios e individuos asignables a *xanthopteryx*; una población al este del CSB presenta solamente individuos de *xanthopteryx*. El oeste del CSB podría ser una zona de contacto secundario entre una población de individuos de hombros verdes aún no descubierta e individuos de *xanthopteryx*. Alternativamente, la variación encontrada podría deberse a un fenómeno de diferenciación actual o bien de un polimorfismo cromático extinguido en otros puntos de su distribución.

Turquoise-fronted Amazon *Amazona aestiva* comprises two subspecies: *A. a. aestiva*, which occurs over much of eastern Brazil and is chiefly characterised by a red shoulder, and *A. a. xanthopteryx*, of Bolivia and south-west Brazil to northern Argentina which has a yellow shoulder with some red markings<sup>3,6,14</sup> (Fig. 1). They are mostly allopatric, but overlap in central Mato Grosso, Brazil<sup>4</sup> (Fig. 1). Like other wide-ranging species, Turquoise-fronted Amazon occurs in many different habitats, though some are clearly preferred<sup>1,16</sup>. It inhabits dry tropical and subtropical forests mainly in the Chaco and *Cerrado*<sup>2,3</sup>. In Argentina, it is typical of Chaco and transitional forests though it was, at least formerly, present in small numbers in the interior Atlantic Forest. In Paraguay, the species is mostly found in the Chaco<sup>7</sup>, and in Brazil, mostly in the *Cerrado* and less commonly in Amazonia<sup>17</sup>. My aims here are to: (a) describe a previously unknown variant of this species from the western Sierra de Santa Bárbara range in north-west Argentina, (b) characterise the colour variation in two populations, one to the east and the other west of the Sierra de Santa Bárbara, and (c) suggest explanations for the geographic variation observed.

### Methods

Field work was undertaken on both slopes of the Sierra de Santa Bárbara (SBC) which comprises three mountain ranges: the Sierra de Santa Bárbara, El Centinela and Maíz Gordo. The complex runs north to south for c.150 km (23°53'S 64°27'W to 25°11'S 64°55'W), with a mean ridge height of c.2,600 m. Data were gathered during the course of Proyecto Elé (a project working on the

sustainable use and conservation of the Turquoise-fronted Amazon in Argentina), at Finca Cachepunco (24°16'S 64°40'W, 550 m, prov. Jujuy, on the west slope of the SBC and in plains west of the SBC) on 26 June–2 July 2000 and 9–18 July 2002, and at Finca Las Varas (23°20'S 64°05'W, 330 m, prov. Salta, in plains east of the SBC) on 7–9 July 2000. Parrots were trapped in citrus orchards with traditional lace traps, which do not harm the birds. Traps were set in early morning (c.07h30) and evening (c.18h30) when parrots foraged in the citrus trees. I examined over 250 birds and photographed 120 of these, but did not collect any. Birds were aged by iris colour to test for a relationship between plumage pattern and age. Additionally, I studied 60 specimens from throughout the Argentine range of the species, held at the Museo de La Plata, La Plata (MLP), Museo Argentino de Ciencias Naturales, Buenos Aires (MACN), and Instituto Miguel Lillo, Tucumán (IML).

### Results

Field work in the Sierra de Santa Bárbara revealed previously unreported geographic variation in the Turquoise-fronted Amazon. Variation in colour pattern was abundant both west and east of the SBC, but two extreme phenotypes were distinguished: 1) yellow-and-red shouldered birds (race *xanthopteryx*) and 2) green-shouldered individuals (subspecies unknown). Birds east of the SBC were variable, but variation was within that of typical *xanthopteryx* (Fig. 1). Green-shouldered individuals were captured only west of the SBC. Whereas *xanthopteryx* is overall brilliant pale green, those west of the SBC are overall dark opaque green, and

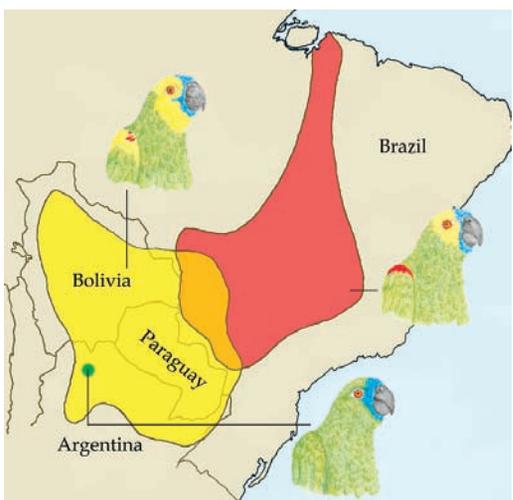


Figure 1. Distribution and geographic variation of Turquoise-fronted Amazon *Amazona aestiva*. Yellow = race *xanthopteryx*, red = *aestiva*, orange = contact zone between *aestiva* and *xanthopteryx*, and green = green-shouldered birds from the west side of the Sierra de Santa Bárbara range.

whilst *xanthopteryx* has yellow-and-red shoulders and a yellow crown, these individuals had green shoulders and a mostly green head, with the turquoise on the forehead sometimes extending to the rear and lacking any yellow (Fig. 2). The population west of the SBC exhibited unexpectedly high levels of variation; some were typical *xanthopteryx*, others were green-shouldered and most were intermediate. A random sample of birds trapped in June/July 2000 at Finca Cachepunco (west side;  $n=38$ ) comprised five (13%) green-shouldered, 25 (66%) intermediate and eight (21%) typical *xanthopteryx*. In contrast, all those at Finca Las Varas (east side;  $n=63$ ) were typical *xanthopteryx*. West of the SBC, all colour variants are syntopic in winter, participating in the same feeding and roosting flocks.

Whilst parrots east of the SBC occurred in dry Chaco dominated by *Schinopsis lorentzii* and *Aspidosperma quebrachoblanco*<sup>11</sup>, those to the west used two different habitats: on the lower slopes of the SBC (at mid elevations), transitional forest<sup>2</sup> dominated by *Anadenanthera colubrina*, *Enterolobium contortisiliquum*, *Phyllostylon rhamnoides* and *Patagonula americana*, and on the plains (at lower elevations) dry Chaco with transitional forest elements.

Examination of birds of comparable age (both fledglings and adults) throughout the SBC revealed that the variation described above is not age-related. All specimens that I examined (none from areas west of the SBC) displayed features of *xanthopteryx* and do not contribute to understand-



Figure 2. Individuals from the west side of the Sierra de Santa Bárbara showing green-shouldered, intermediate and *xanthopteryx* individuals, prov. Jujuy, north-west Argentina (Juan Ignacio Areta)

ing of the geographic variation found in the SBC. The closest two were taken at Yuto, prov. Jujuy ( $23^{\circ}37'S$   $64^{\circ}27'W$ ). This suggests that the green-shouldered birds are rather locally distributed on the western side and slopes of the SBC.

## Discussion

My findings reveal that on the western side of the Sierra de Santa Bárbara, there is a highly variable population of Turquoise-fronted Amazon that includes a previously unreported variant lacking any yellow and red in the plumage. These green-shouldered individuals are very distinctive, and are as diagnosable as those of the two named subspecies of Turquoise-fronted Amazon. In contrast, Turquoise-fronted Amazons east of the SBC and, presumably, throughout the rest of the species' range in Argentina are pure *xanthopteryx*. Green-shouldered Turquoise-fronted Amazons mirror the case of the form *auropalliata* of Yellow-headed Amazon *Amazona ochrocephala*, which lacks both the yellow on the head and the red in the shoulders that are present in other forms within this group<sup>5,9</sup>. I propose two alternative hypotheses to explain the existence of green-shouldered, intermediate and *xanthopteryx* individuals on the west slope of the Santa Barbara range.

First, the west side of the Santa Bárbara range may represent a contact zone in which *xanthopteryx* and a pure green-shouldered population overlap or formerly did so. In general, geographic races might overlap in a contact zone, in which their distinctive characters are lost to some degree due to hybridisation. Contact zones usually contain pure individuals from both populations and impure individuals which more or less resemble either parental type<sup>10,12</sup>. In central Mato Grosso, Brazil, *aestiva* and *xanthopteryx* overlap in a contact zone (Fig. 1) characterised by the presence of intermediate and pure phenotypes<sup>17</sup>. The degree of isolation between populations east and west of the SBC is unknown, but to cross the range would require overflying a 2,600-m ridge, which could act as an

effective barrier to dispersal by parrots. Supporting the secondary contact hypothesis, the Santa Bárbara range harbours an endemic population of White-browed Tapaculo *Scytalopus superciliaris santabarbarae*<sup>8,13</sup>, showing the potential for isolation and differentiation in the region.

Secondly, the green-shouldered individuals may be the product of an ongoing differentiation process or simply a persistent old polymorphism that has disappeared from other parts of the range.

The closely related Yellow-headed Amazon exhibits high levels of plumage variation not satisfactorily accounted for by described subspecies<sup>5,9,15</sup>. Moreover, South American races in the latter complex do not reflect patterns of genetic variation<sup>5,9,15</sup>, thereby urging caution when endeavouring to interpret plumage variation in Turquoise-fronted Amazon. For now, how to classify taxonomically the green-shouldered individuals is unclear. Future studies of this parrot in the Sierra de Santa Bárbara should quantify the degree and extent of geographic variation in the species by sampling the area for clines, pure green-shouldered populations farther west, and mixed populations at other localities, in order to clarify the systematic and evolutionary origin of those populations on the west side of the range.

#### Acknowledgements

I thank the directors of Proyecto Elé, Ricardo Banchs and Flavio Moschione, without whom I would not have made this discovery, all of my team mates from Proyecto Elé, and especially Pablo Grilli for his friendship. The paper greatly benefited from useful criticism by Kristina Cockle, Kini Roesler, Guy Kirwan, and two anonymous reviewers. Igor Berkunsky assisted with data on the mountain ranges. Solana Vila Moret drew the beautiful parrots to illustrate the map.

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