

Taxonomy, history, and status of Alagoas Curassow *Mitu mitu* (Linnaeus, 1766), the world's most threatened cracid

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RESUMO: O mutum-de-Alagoas *Mitu mitu* foi, por mais de 40 anos, considerado como uma raça geográfica do mutum-cavalo, *Mitu tuberosum*, sendo o seu status taxonômico como espécie plena motivo de controvérsia na literatura. No presente trabalho nós analisamos e discutimos todos os caracteres diagnósticos propostos para essa espécie, confirmando a sua validade como espécie. O histórico desta espécie, endêmica do “Centro Pernambuco”, avaliada como extinta na natureza e considerada como criticamente ameaçada de extinção é revisto, e todas as localidades conhecidas são mapeadas. Os caracteres que corroboram *M. mitu* como espécie plena são encontrados no bico, de base vermelha e porção apical rósea, na região auricular, que é nua, e na cauda, que possui o par central de retrizes totalmente negro e as restantes com o ápice marrom, havendo também suporte de dados moleculares. Durante os meses de outubro e novembro de 2001 foram realizados estudos em diversos fragmentos em Alagoas para se buscar indivíduos remanescentes na natureza, não resultando em sucesso; a maioria dos fragmentos amostrados sofria com a caça intensiva e a extração de madeira, embora alguns usineiros estejam preocupados em proteger os seus fragmentos florestais. Neste trabalho nós também revisamos o histórico da população em cativeiro, com a atualização do número de aves existentes, incluindo os indivíduos híbridos. Para se efetivar os projetos de reintrodução os fragmentos florestais devem ser muito bem protegidos, e a população local, com uma forte tradição de caça esportiva, deve ser objeto de programas de educação ambiental.

PALAVRAS-CHAVE: Mutum-de-Alagoas, *Mitu mitu*, Alagoas, Centro Pernambuco, Criação em cativeiro, Extinção.

ABSTRACT: Alagoas Curassow *Mitu mitu* has long been subjected to taxonomic discussions as to its validity as a full species or as a member of a polytypic assemblage which includes the Razor-billed Curassow *Mitu tuberosum*. In this paper we review the history of this highly threatened taxon (now extinct in the wild) endemic to north-eastern Brazil, including summarising and mapping known localities for the species. We analyse and discuss all previously published proposed diagnostic characters for *M. mitu* and confirm its validity as a full species based on diagnostic characters of a bicoloured bill, bare auricular patch, tawny-tipped tail and nearly all-black central rectrices (molecular evidence also support this conclusion). We detail surveys carried out in north-eastern Brazil in October–November 2001 which were unsuccessful in finding extant populations of *M. mitu* but encountered widespread hunting and some wood extraction in the few remaining forest blocks. There is, however, landowner support for protecting the remaining forests in the majority of areas. The captive population history and management is given including information on current location and provenance. Before reintroduction of *M. mitu* to the wild is possible many conservation measures will be needed at the chosen forest location, including better protection, monitoring, and educational work with local people.

KEY WORDS: Alagoas Curassow, *Mitu mitu*, Alagoas, Centro Pernambuco, Captive breeding, Extinction.

INTRODUCTION

During the “Mauritian Period” (1637–1644) the Dutch occupied part of the north-eastern coast of Brazil. Their legacy was a significant contribution to the area’s natural history, especially by naturalists and artists of Prince Maurice of Nassau-Siegen’s court. Among them was the German naturalist J. Marcgrave (Teixeira 1992) whose texts and illustrations published in 1648 were later used by scholars to describe for science many Brazilian animals. Among the birds represented by Marcgrave was the “Mitu” or “Mutu” described by Linnaeus (1766) as *Crax mitu* (= *Mitu mitu*,

Alagoas Curassow). Two centuries after Marcgrave and almost sixty years after Linnaeus, Spix (1825) described *C. tuberosa* (= *Mitu tuberosum*, Razor-billed Curassow) based on specimens collected along the Rio Solimões in Amazonia.

The lack of any later material from north-east Brazil allowing direct comparisons of *Mitu mitu* with *M. tuberosum* caused speculation about the origin and validity of the bird originally figured and described by Marcgrave, and various taxonomic treatments followed. The curassow described by Spix was long considered a synonym of *M. mitu* (e.g. Ogilvie-Grant 1893, Hellmayr and Conover 1942). Only after 1951, when an adult female curassow was collected in the

coastal forests of Alagoas state, north-east Brazil, did *M. tuberosum* begin to be treated by some as a distinct taxon from *M. mitu*, either at the species level (Pinto 1952) or as a subspecies (e.g. Pinto 1964, 1978, Delacour and Amadon 1973, Sick 1980, 1985, Teixeira 1992), although some continued to regard the two as identical (Vuilleumier 1965, Vaurie 1967). More recently, *M. mitu* has been treated by several authors as a full species status (e.g. Collar *et al.* 1992, 1994, Nardelli 1993, del Hoyo 1994, Sick 1997, BirdLife International 2000, del Hoyo and Motis 2004).

Hellmayr and Conover (1942) suggested north-east Brazil as the type-locality of *Mitu mitu* and Pinto (1964, 1978) suggested Pernambuco state probably because Marcgrave's specimens and writings were mainly based there. However, Teixeira (1997) observed that the original distribution of the bird illustrated by Marcgrave in 1648 could have involved all the coastal forests below 400 m a.s.l. from Rio Grande do Norte state (c.06°20'S) in the north, south to the north margin of the Rio São Francisco in Alagoas (c.10°24'S).

Nevertheless all confirmed sight and specimen records are from Alagoas state (Teixeira 1986, Nardelli 1993) from an area covering less than 2,500 km², which is a tiny range and much smaller than any other large cracid species (Figure 1). Pinto (1952) rediscovered the *Mitu mitu* in 1951 in the forests of São Miguel dos Campos. The species went unrecorded from 1951 to 1976 when Nardelli (1993) found and caught some individuals at Roteiro. Teixeira (1986) also reported curassows from surveys in lowland forest remnants in Roteiro, Barra de São Miguel, Pilar and Marechal Deodoro in the early 1980s. He estimated that fewer than 60 birds were then left in the wild. The last reports of wild birds date from the late 1980s (Collar *et al.* 1992).

Several early authors (e.g. Coimbra-Filho 1970, 1971, Sick and Teixeira 1979, Sick 1980, Teixeira 1986) pointed to the rarity of *Mitu mitu* and to the ongoing destruction of its habitat. Despite this, the last large forest remnants where *M. mitu* lived were destroyed to make way for sugarcane plantations under the now defunct "Proalcool" programme, launched in 1975 by the Brazilian federal government to increase the domestic production of ethanol as a substitute to gasoline (Teixeira 1986, 1997, Cavalcanti 1992). Habitat destruction has left less than 2% of the original Atlantic Forest remaining in north-eastern Brazil, much of it second-growth (Silva & Tabarelli 2000); this and hunting pressure are held responsible for the demise of the species, which is treated as Extinct in the Wild (Collar *et al.* 1992, 1994, BirdLife International 2000, IBAMA 2003).

This contribution has the objective of analyse the characters proposed as a diagnostic of *Mitu mitu*, and summarize the history of this species in the wild and in captivity.

MATERIAL AND METHODS

There are six skins, some parts of one individual and one skeleton known in scientific collections. Skins of an adult female collected by Pinto (1952) and a pair recently received from the captive stock plus one skeleton (a male) are housed in the Museu de Zoologia da Universidade de São Paulo. There is a specimen in Museu Nacional do Rio de Janeiro (MNRJ) donated by P. Nardelli in 1979, and also the parts

of one individual obtained in Alagoas (without more details). The private collection of Rolf Grantsau in São Paulo has skins of two chicks taken from failed eggs also donated by Nardelli. We compared Pinto's specimen of *Mitu mitu* at MZUSP with a series of nine adult female *M. tuberosum* (Appendix), and some captive specimens were handled by LFS in order to check the number of rectrices. This enabled us to make a critique of previous work that proposed diagnostic characters of *M. mitu*. Color designations were determined through direct comparison with Smithe (1975); measurements of bill and tarsometatarsus were taken with a digital caliper while the measurements of tail and wing (chord) were taken with a steel tape (see Table 2).

We also conducted surveys in several forest fragments in Alagoas between 24 September and 27 October 2001 to assess their conservation status, and to search for several Atlantic Forest endemic birds, especially *Mitu mitu* (see details of methods and study area in Silveira *et al.* 2003a). We visited 15 localities (Fig. 1); a summary of their characteristics is given in Table 1. We looked especially for the larger forest remnants where, given the ecology of the curassow, its survival was more likely. Although *M. mitu* was never proven to occur in Pernambuco or Paraíba states to the north, we carried out surveys there in November 2001, bearing in mind Teixeira's suggestion that it once occurred more widely, like other bird taxa found throughout the north-eastern Atlantic coastal forests.

RESULTS AND DISCUSSION

Diagnostic characters: a re-analysis: In the original text and illustration of Marcgrave (1942) there are two characters, namely a bare auricular patch and a bicoloured bill which we believe are diagnostic characters distinguishing *Mitu mitu* from *M. tuberosum*. Curiously, neither of these features was amongst the eight diagnostic characters for *M. mitu* listed by Pinto (1952); and in fact our larger sample of comparative material shows that six of Pinto's characters are not diagnostic (see Table 2).

Vaurie (1967:10) concluded that the characters and the picture presented by Pinto (1952) referred to a typical immature of *Mitu tuberosum*, and that it "...leaves no doubt that this bird was immature and that it does not differ in any respect from immature birds from the Amazon basin". Delacour and Amadon (1973), although considering *M. mitu* distinctive from its Amazonian counterpart, thought that some of the characters listed by Pinto could indicate immaturity, although Pinto (1952: 325) had reported that the bird was "female in excellent conditions of development and plumage". None of these authors examined the specimen collected by Pinto, which is indeed clearly an adult bird by plumage and measurements. Furthermore, three-month-old *M. mitu* already show a plumage very similar to the adults, and by five months their size approaches that of adults (Heinroth 1931, Nardelli 1993). Sick (1980), studying a female from Nardelli's collection, also noted as diagnostic characters the bare auricular patch and the bill colour, dark-red at the base becoming whitish towards the tip; Nardelli (1993) listed 14 rectrices as a diagnostic characteristic.

Nardelli's (1993) suggestion that 14 rectrices is a diagnostic character of *Mitu mitu* was not supported by our



Figure 1: Historical distribution of *Mitu mitu*. Dots show localities where birds were reported. 1. São Miguel dos Campos (09°46'S 36°05'W); 2. Roteiro, including Lagoa do Jenipapo (09°49'S 35°58'W); 3. Barra de São Miguel, including Mata do Othon (09°50'S 35°54'W); 4. Pilar (09°35'S 35°57'W); 5. Marechal Deodoro (09°47'S 35°53'W).

The grey-filled circles are localities surveyed by the authors in the present paper (see also Table 3 and Silveira *et al.* 2003a), namely: A, Mata do Pinto, Usina Serra Grande; B, Mata da Petrópolis, Usina Serra Grande; C, Mata da Encosta do Grotão, Usina Camaragibe; D, Grotão do Brás, Mata de Santa Justina, Usina Santo Antônio; E, Mata da Santa Justina, Usina Santo Antônio; F, Torre da Embratel, Murici Ecological Station; G, Mata da Sela, Usina Cachoeira; H, Usina Santo Antonio 2; I, Usina Santo Antonio 1; J, Mata Bamburral II, Usina Cachoeira; K, Mata do Cedro, Usina Utinga-Leão; L, Mata da Sálvia, Usina Utinga-Leão; M, Mata do Capiatã, Usina Coruripe; N, Mata do Riachão, Usina Coruripe; O, Fazenda Riachão, Usina Coruripe

data. This unusual character for Cracidae (all other members of the family have 12 rectrices) was object of a special investigation by us because the wild-caught specimen we examined in MZUSP has 12 rectrices and shows no sign of any missing feathers. Additionally Taibel (1939) reported the presence of 14 rectrices instead of 12 in a captive-born male Great Curassow *Crax rubra*, later finding that this phenomenon, which he named “poliuroptilia”, could be transmitted to offspring (Taibel 1947). The presence of 14 rectrices as a diagnostic character of *M. mitu* was checked by us by direct comparison of pure captive birds, after their phenotypic and genetic determination. During the end of 2003, one of us (LFS) had the opportunity of handle 44 individuals of *M. mitu* (nine hybrids) and, from the 35 birds considered pure

by us (having the four morphological characters cited above), the number of rectrices varied from 12 to 15, and 23 of them had 14 rectrices. This result seem to support the phenomenon of “poliuroptilia”, and we suggested here that the pure, 12 tail-feathers birds, should be managed apart from the main group and that its offspring should be checked regarding the number of rectrices.

On the basis of our comparisons of Pinto's Alagoas specimen with nine female of *Mitu tuberosum*, we propose that the diagnostic characters of *Mitu mitu* are (1) a bicoloured bill, (2) a bare auricular patch, (3) a tail with pale tawny (color 38 of Smithe 1975) rather than white tips and (4) nearly all-black (i.e. untipped) central rectrices (Table 2). We believe these characteristics show that the specific status of *M. mitu* should be maintained under the phylogenetic and biological species concept, since they represent differences of a quality and type equivalent to those that are admitted as species-level differences between the three Amazonian representatives of *Mitu*, Crestless Curassow *M. tomentosum*, Salvin's Curassow *M. salvini* and *M. tuberosum*. Further evidence comes from an analysis of 760 base pairs from mitochondrial cytochrome b and control region sequences. A comparison of pure *M. mitu* (including the MZUSP skin and 20 captive specimens) with *M. tuberosum* found a 2.6% divergence, almost the same found between *M. tuberosum* and Crestless Curassow *Mitu tomentosum* (2.8%, Grau *et al.* 2003). It is important to point out that all individuals which had its DNA studied and were considered as *M. mitu* exhibited all four characters cited above in a consistent way, leading us very confident in its use as a tool to identify pure *M. mitu*.

The measurements of our *Mitu tuberosum* sample are quite similar to measurements of the single adult female *M. mitu* specimen (Table 3). However, the *M. mitu* specimen appears to be shorter-legged and shorter-billed, with a greater wing:tail ratio, but these differences cannot be considered diagnostic without a larger sample.

Boev (1997) reported an old captive specimen (it died in 1938) of *Mitu mitu* in the National Museum of Natural History, Sofia, Bulgaria, but based on his description and the reported location of its collection we believe it to be a *M. tuberosum*. Although it is considered to have a bicoloured bill and smaller casque, it has no all-black central pair of rectrices, no buffy tips to the lateral rectrices, and no bare auricular patch. It was labelled as being from “Guyana, Amazon River”, which is a more like transport route for the Amazonian *M. tuberosum*.

The captive population: Nardelli (1993) reports his efforts to rescue the last wild *Mitu mitu*. He obtained the first individual (a female caught in Roteiro) in November 1976, but which died in captivity the following year. At the end of 1978 he observed three curassows feeding on the fruits of a Myrtaceae tree at Lagoa do Jenipapo, also in Roteiro. An active nest was also found there. This forest, totalling about 10,000 ha, was destroyed in eight months to make room for sugarcane plantations (“usinas”) to supply Usina Roteiro.

In January 1979 six birds were observed at Mata do Othon, Barra de São Miguel. Five of them were captured and brought into captivity before the area suffered the same fate as forest at Roteiro. An additional captive female was obtained in Maceió, making a total captive population of six birds from Alagoas. Of these one died soon afterwards

Table 1: Localities visited in Alagoas during bird surveys in search of *Mitu mitu*, ordered from north to South. The letters correspond with the labels on Figure 1.

Locality	Location	Area (ha)	Field-hours	Description and notes
A - Mata do Pinto, Usina Serra Grande	08°58.74'S 36°06.18'W. 160 m asl	c. 300	5.4	Ombrophyllous hilltop forest with a 20 m-high canopy, showing evidences of selective logging long ago. Many fruiting <i>Didymopanax morototoni</i> and melastomes, the latter forming a belt around parts of the fragment. Open undergrowth with sedge patches. Creeks and two water reservoirs in the fragment.
B - Mata da Petrópolis, Usina Serra Grande	09° 00.85'S 35° 52.93'W, 590 m asl	c. 800	5.1	Tall ombrophyllous forest with a 20–25 m-high canopy and emergents over 30 m. Many palms (<i>Attalea</i> , <i>Euterpe edulis</i>) and arboreal bromeliads. Many fallen fruits (Sapotaceae and Anonaceae) gnawed by parrots. Several creeks. No evidence of selective logging. Eight poachers (plus six hunting dogs) recorded during survey time.
C - Mata da Encosta do Grotão, Usina Camaragibe	09°07.42'S 35° 34.69'W, 160 m asl	c. 100	4	Very degraded ombrophyllous forest under severe selective logging. No permanent source of water. A few emergent <i>Parkia</i> .
D - Grotão do Brás, Mata de Santa Justina, Usina Santo Antônio	09°13'04''S 35° 31'29''W, 50 m asl	c. 100	7	Well-conserved ombrophyllous forest in the narrow steep valley of a small river with a 25 m-high canopy. Many emergents (<i>Parkia pendula</i> and <i>Lecythis pisonii</i>). Many palms, including fruiting <i>Euterpe edulis</i> . Open and species-rich undergrowth. An old trail, obstructed at points, leads to the forest.
E - Mata da Santa Justina, Usina Santo Antônio	09°13'47''S 35° 30'4''W, 30 m asl	c. 80	11	Ombrophyllous forest with evidence of past selective logging, in a steep narrow valley. Reasonably conserved, with emergent <i>Parkia</i> . There are some trails used by poachers and loggers.
F – Torre da Embratel, Murici Ecological Station	09°14.59'S 35° 47.47'W. 470 m asl	c. 300	2.5	Second-growth montane forest, very damaged. Most trees show multiple trunks due to resprouting from former cutting. Taller trees belong to non-commercial species. Many secondary species like <i>Cecropia</i> . Area under intensive logging.
G - Mata da Sela, Usina Cachoeira	09°22.79'S 35° 43.51'W. 160 m asl	c. 100	2	Dry forest in a hillside with many exposed boulders. Very degraded by selective logging. A few emergents up to 30 m high tower over a 8 m-high canopy of second-growth species (<i>Cecropia</i> , Melastomaceae). Undergrowth with many sedges.
H – Usina Santo Antonio 2	09°23.38'S 35° 35.35'W, 30 m asl	c. 25	4	Ombrophyllous forest in a steep narrow valley with creeks. Several large trees and emergents (mostly <i>Parkia pendula</i>), open understorey. No evidence of recent logging. Several poacher hides found.
I – Usina Santo Antonio 1	09°23.39'S 35° 37.21'W, 100 m asl	c. 80	7	Ombrophyllous forest in a steep narrow valley with a creek. Few patches of larger trees amid tangled, damaged second-growth; some large land bromeliads, emergent trees (mostly <i>Parkia pendula</i>). Intensive on-going selective logging. Several poacher hides found.

Locality	Location	Area (ha)	Field-hours	Description and notes
J - Mata Bamburral II, Usina Cachoeira	09°26.81'S 35° 41.33'W, 150 m asl	c. 500	2.1	Ombrophyllous forest in a steep, narrow valley with a creek. Large emergents (<i>Parkia pendula</i> and <i>Aspidosperma</i> sp.) amid many second-growth species (<i>Inga</i> , <i>Cecropia</i>). An abandoned camp (made by poachers?) found in the forest.
K - Mata do Cedro, Usina Utinga-Leão	09°31.86'S 35°54.81'W, 120 m asl	c. 500	7	Ombrophyllous tall forest with many emergents (<i>Parkia</i>) and large <i>Attalea</i> palms. It is connected to other fragments and total area may reach 1,000 ha. Slopes show tall forest with open understorey; flat areas were selectively logged and have lower trees and tangled understorey. The forest surrounds a large water reservoir. One gunshot heard during survey time.
L - Mata da Sálvia, Usina Utinga-Leão	09°32.28' S 35° 50.09'W, 160 m asl	c. 400	4	Ombrophyllous forest in a valley with open undergrowth. Many tall emergents (<i>Parkia pendula</i>). The forest centre is surrounded by a belt of <i>Cecropia</i> and other secondary species. Selective logging of poles, poaching and capture of cage-birds recorded.
M - Mata do Capiatã, Usina Coruripe	10° 00.12'S 36° 16.10'W, 150 m asl	458	6	Linked to the previous fragment, with similar vegetation in better drained areas. Has 3 creeks surrounded by ombrophyllous forest with trees over 40 m. Those feed a large reservoir surrounded by the forest. A village with 400 people existed by the forest, which is surrounded by a ring of second-growth. Three poachers seen during survey time.
N - Mata do Riachão, Usina Coruripe.	10° 03.35'S 36° 16.52'W, 100 m asl.	454	2.1	Drier forest with many Brazilwood trees and very large fig-trees. A small perennial creek. Upper canopy at 25 m, with emergents over 40 m. No evidence of recent logging.
O - Fazenda Riachão, Usina Coruripe	10° 03.52'S 36° 16.42'W, 120 m asl.	337	6	Drier forest with many Brazilwood <i>Caesalpinia echinata</i> trees. No perennial creek. Upper canopy at 20 m, with emergents over 30 m. No evidence of recent logging. Several poacher hides found.

leaving five to begin a captive breeding project at Nardelli's private bird collection ("Zoobotânica Mario Nardelli"). According to Nardelli (1993) none was captured after 1979, and there is no information on any captive *M. mitu* from any other sources.

The five surviving individuals captured in 1979 were separated as a pair and a trio of a male and two females. The male (still alive in November 2003) of the pair is too imprinted on humans and has never bred. However, between 1979 and 1990 the trio produced 19 young. From the 19 young, 12 were males and seven females (Nardelli 1993: 245), with five (2 males and 3 females) dying during the same period, leaving 14 survivors plus the five original birds. The world population of *Mitu mitu* in 1990 stood at 19 birds (12 males and 7 females).

After 1990, the surplus of males prompted Nardelli to hybridise birds with *Mitu tuberosum*, on the assumption he

could backcross the resulting birds into "pure" *M. mitu*. It is to be noted that at no time did the government agency in charge of conserving threatened species (IBAMA, formerly IBDF) take any steps either to protect the *M. mitu*'s habitat or—in what Collar *et al.* (1992) described as "an extraordinary circumstance"—to seek any involvement in the direction of captive-breeding efforts, leaving the whole matter to Nardelli's discretion.

The hybrid pairs proved viable and the captive population reached 42 birds in May 1993, at least 8 of them hybrids (Nardelli 1993). The number of captive birds changed little after that, and in 1999 there were 44 birds, of which only 12 were pure-bred individuals descended from the original trio caught in 1979.

With the closing of the Zoobotânica Mário Nardelli in 1999, the world population of *Mitu mitu* was split, with 20 birds (a pair of pure birds) sent to the Criadouro Científico

Table 2: Analysis of the diagnostic characters of *Mitu mitu* proposed by Pinto (1952; P), Sick (1980; S) and Nardelli (1993; N), compared with the present study.

Proposed diagnostic characters	Analysis
Bill of moderate size, laterally compressed (P)	Females of <i>Mitu tuberosum</i> also possess this character – not confirmed as a diagnostic
Base of the bill dark red, becoming whitish toward the tip (S)	Confirmed as a diagnostic character
Crest smaller than in <i>Mitu tuberosum</i> (P)	Females of <i>Mitu tuberosum</i> also possess crest with similar size – not confirmed as a diagnostic character
Bare auricular patch (S)	Confirmed as a diagnostic character
Colour of the belly light ferruginous (color 41 of Smithe 1975), darker in the crissum (P)	This pattern is also found in <i>Mitu tuberosum</i> – not confirmed as a diagnostic character
14 rectrices (N)	This character is not observed in the wild specimen collected by Pinto. Not confirmed as a diagnostic character (see text for further explanation).
Central rectrices black or nearly all black (P)	Confirmed as a diagnostic character
Lateral rectrices with tawny (color 38 of Smithe 1975) tips (P)	Confirmed as a diagnostic character
Ferruginous (color 41 of Smithe 1975) patch at the base of the neck (P)	Present only in the specimen collected by Pinto, and seen again in only one captive specimen – not considered as diagnostic
Border of the feathers with some brownish and slightly brilliant (P)	Present also in <i>Mitu tuberosum</i> . Not confirmed as a diagnostic character
Smaller, in all measurements, than <i>Mitu tuberosum</i> (P)	See Table 2 – not confirmed as a diagnostic character

Table 3: Measurements of MZUSP specimen of *Mitu mitu* and summary statistics [$\bar{x} \pm SD$ (n)] of females of *M. tuberosum*. All measurements are in millimeters.

Species	Bill	Wing (chord)	Tail	Tarsus
<i>Mitu mitu</i>	52	370	334	102.4
<i>Mitu tuberosum</i>	58.98 \pm 3.66 (09)	387.22 \pm 13.13 (09)	332.67 \pm 18.44 (09)	110.68 \pm 3.33 (09)

e Cultural Poços de Caldas, Poços de Caldas (CCCPC), owned by Moacyr de Carvalho Dias, and 24 birds (seven pure, 3 males and 4 females) to Fundação Crax (FC), run by Roberto M. A. Azeredo. Since the split of the collection there have been 22 chicks raised at CCCPC and 40 at FC, the total population reaching 99 birds in April 2004.

Recent surveys in forest fragments in Alagoas – any curassows still there? All areas visited in Alagoas between September and October 2001 belonged to sugarcane plantation companies, each covering tens of thousands of hectares. The areas are remnants of the great cutover of the late 1970s and early 1980s and were left standing either because of local topography or in order to protect water supplies (most are in narrow, steep valleys called *grotões*). We found that most fragments suffer intensive hunting, with

selective logging continuing in some of them (e.g. Usina Santo Antônio).

Most visited “usinas” have recently decided to protect their forests and have some kind of wardening, but evidence of small-scale logging is common (Table 2). Poaching is a serious problem throughout Alagoas, as there are strong local hunting traditions (as well as in other parts of north-eastern Brazil). People from several social levels are engaged in the activity. Despite many of years of fieldwork throughout Brazil, LFS and FO have never met hunters as frequently as they did in Alagoas (Silveira *et al.* 2003a, b). Hunting is illegal with offenders theoretically facing large fines, but it was shocking to discover that poachers seen at Usina Utinga-Leão, our survey site closest to the state capital Maceió, were high-ranking police officers.

No physical evidence (tracks, feathers or calls) of curassows was found. Hunters interviewed in or close to the *Mitu mitu*'s range usually assured us that curassows were extinct, although some could describe the birds in detail and point to areas in which they formerly occurred. One hunter recounted that in February 2001 he met a group of four or five curassows crossing the dirt road that bisects Usina Santo Antônio 1, and shot and missed one of them. Despite this man being able to describe a curassow fairly accurately, our surveys at Usina Santo Antônio 1 found no curassows and plenty of evidence of intensive hunting and logging. We believe this may have been just another hunter's tale. We discovered a small hamlet near Fazenda Petrópolis, Usina Santo Antônio, named "Mutum" (*mutum* is the Brazilian word for curassow). This location is further inland, and at a slightly higher altitude (800 m a.s.l.) than the confirmed range (Figure 1), but the tall remnant forest appeared to be suitable habitat for a curassow, with many creeks and an abundance of trees with fleshy fruits (Table 3).

The future of the species: *Mitu mitu* has been plagued by almost all factors known to have caused recent bird extinctions, and the current genetic bottleneck in the captive stock poses a real management challenge to its global survival. Some guidelines were established to ensure recovery of the species. The "original" stock had their DNA investigated in order to guide pairings and ultimately to increase genetic variability in the population. The hybrids are actually managed apart from pure birds, keeping in mind they may have to be used as a last resort to increase genetic variability in case of insurmountable problems with the pure-bred stock, and also to pilot reintroduction attempts. It is crucial that the captive-breeding programme be conducted in a dedicated, scientifically oriented way, under the supervision of IBAMA.

Once a viable captive population has been created, work to reintroduce the species should be reviewed. Larger forest remnants such as those located at Usina Utinga-Leão and Usina Serra Grande would appear to us to have the greatest potential for reintroduction. Surveys to check for suitable habitat will need to be conducted, and perhaps releases involving neutered hybrid or *Mitu tuberosum* attempted. This could be an effective way to refine management techniques and identify problems before risking any *M. mitu*.

However, any attempt to reintroduce *Mitu mitu* must also include educational work with local communities to alter hunting habits. Police officers and other people who apply environmental laws themselves need targeting in this respect. Any reintroduction will need constant protection measures, as even a single dedicated poacher could kill off a curassow population. These actions must be given a high priority and be taken well in advance of any release to ensure that the local human population has been engaged as a partner to the effort.

Against the odds the *Mitu mitu* has survived into the twenty-first century. There is still hope for the species in spite of a 30-year delay in taking action to save the remaining lowland forests of Alagoas and scientific-based management of the captive population. Several bird species have recovered from similar or even more critical population levels. We believe that with sufficient effort, funding and commitment based on sound conservation science it will be possible to return this species to Alagoas.

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APPENDIX: MATERIAL EXAMINED

In sequence: catalogue number, locality, date and collector. All individuals were sexed as females, except otherwise indicated. **MZUSP**: Museu de Zoologia da Universidade de São Paulo, **SG**: Grantsau collection

***Mitu mitu* (Linnaeus, 1766)**

- MZUSP 37.188, São Miguel dos Campos, Alagoas, 5.x.1951, José Pedro;
 SG 10177, unsexed captive specimen (young taken from egg), Nardelli;
 SG 10178, unsexed captive specimen (young taken from egg), Nardelli.

***Mitu tuberosum* (Spix, 1825)**

- MZSUP 2.733, Rio Juruá, AM, vii.1902, Garbe;
 MZUSP 20.466, Piquiatuba, Rio Tapajós, PA, 01.vii.1936, Olalla;
 MZUSP 21.811, João Pessoa, Rio Juruá, AM, 02.ii.1937, Olalla;
 MZUSP 21.813, João Pessoa, Rio Juruá, AM, 28.i.1937, Olalla;
 MZUSP 21.852, Lago do Batista, Rio Amazonas, AM, 30.iii.1936, Olalla;
 MZUSP 21.879, Foz do Rio Curuá, Rio Amazonas, PA, 14.xii.1936, Olalla;
 MZUSP 21.880, Foz do Rio Curuá, Rio Amazonas, PA, 13.xii.1936, Olalla;
 MZUSP 21.930, Caxiricatuba, PA, 03.xii.1936, Olalla;
 MZUSP 28.037, Amazônia, 1936, Olalla.