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Rediscovery of the White-cheeked Parrot *Amazona kawalli* (Grantsau and Camargo 1989), with notes on its ecology, distribution, and taxonomy

Paulo Martuscelli[1] and Carlos Yamashita[2]

[1]Instituto Insularis, C. P. 194, 11750-970, Peruíbe, SP. Brazil. E-mail: insularis@coastalway.com.br
[2]IBAMA Rua Voluntários da Pátria 3714/52, São Paulo 02402-400, Brazil. E-mail:cyama@nethall.com.br

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RESUMO. **Redescoberta do papagaio de cara-branca *Amazona kawalli* (Grantsau e Camargo 1989) na natureza, e notas sobre a sua ecologia, distribuição e taxonomia.** O papagaio-de-cara-branca *Amazona kawalli* (descrito primariamente como *Amazona farinosa* aberratio *rubricauda* Stresemann 1924), é uma das espécies de papagaios menos conhecida do mundo. A sua descrição foi baseada em poucos exemplares, coletados na natureza e de exemplares cativos com procedência desconhecida. O status taxonômico em relação as outras espécies de *Amazona* permanece incerto, sendo considerado por recentes autores como uma mera variação individual do papagaio-moleiro *A. farinosa*, sua espécie supostamente aparentada. Após a coleta do tipo em 1902 e um outro espécime em 1914, esta espécie nunca mais foi encontrada na natureza. Neste trabalho nós registramos as primeiras populações naturais do *Amazona kawalli* encontrado nas cabeceiras do Rio Tapajós e seus tributários, em uma área florestada isolada por serras ao sul da planície Amazônica Brasileira. A distribuição do *Amazona kawalli* esta relacionada com florestas periodicamente inundadas e hábitats de transição, não sendo encontrado em floresta de "Terra Firme" contínua e floresta "Semidecídua", não ocorrendo em simpatria com o papagaio-moleiro *A. farinosa*. Em campo é facilmente identificado por sua voz característica, coloração das partes nuas e morfologia geral. Baseados nestas características nós concluímos que *Amazona kawalli* é uma espécie válida, distinta do papagaio-moleiro *A. farinosa*, sendo as características de diagnose o anel perioftálmico cinza, prega de pele nua ao redor do bico, retrizes laterais tingidas de vermelho na sua parte interna, cerdas presente nos loros e cobrindo as narinas, servindo também para diferenciar os espécimes em museus. As principais ameaças para a sua conservação são a caça para alimentação humana, comércio ilegal, a mineração do ouro e cassiterita, a construção de usinas hidroelétricas e projetos de reforma agrária.
PALAVRAS-CHAVE: *Amazona kawalli, Amazona rubricauda*, ameaçado, conservação, distribuição, nomenclatura, reprodução, Rio Tapajós, taxonomia, vocalização.

ABSTRACT. The White-cheeked Parrot *Amazona kawalli* (first described as *Amazona farinosa* aberratio *rubricauda* Stresemann 1924) is one of the least-known parrots in the world. It was described from a handful of specimens, collected both in the wild and captives from unknown localities. Its taxonomic status in relation to other *Amazona* species remains unclear, being considered by some authors to represent individual variation within the Mealy Parrot *A. farinosa*, its supposed sister species. After the type specimens were collected in 1902 and another specimen in 1914, White-cheeked Parrots were not

found again in the wild. In this paper we report the discovery of the first wild population of White-cheeked Parrots, found in the headwaters of the Rio Tapajós and his tributaries, in a forested area bounded by mountain massifs in the southern Brazilian Amazonian lowlands. The distribution of the White-cheeked Parrot is positively related to seasonally flooded forests and transitional habitats, but it does not occur in the adjacent uplands and semideciduous forest surrounding the lowlands, these habitats are occupied by *A. farinosa*. In the field it was easily identified by its distinctive voice, bare part colors and general morphology. Based on these characteristics we conclude that *A. kawalli* is a valid species distinct from the similarly sized Mealy Parrot *A. farinosa*. The main diagnostic character of *A. kawalli* are being the gray around the eye ring, white mandibular patch, outer rectrices tinged with red at the inner base, and blackish bristles on the lores and covering the nostrils. The main threats to its survival are hunting for food, the pet trade, gold and tin mining, hydroelectric projects, and colonization projects for landless farmers.

KEY WORDS: *Amazona kawalli*, *Amazona rubricauda*, breeding, conservation, distribution, endangered, nomenclature, Rio Tapajós, taxonomy, vocalization.

Supposedly aberrant Mealy Parrots (*Amazona farinosa*) have been described and even illustrated in the ornithological literature. Ihering (1904), referring to material collected in 1902 by E. Garbe on the Juruá River, Amazonas state, identified three parrots (Museu de Zoologia da Universidade de São Paulo - MZUSP 2727, 3478, 2258) as *Amazona inornata* (= *Amazona farinosa inornata*). Later, Ihering and Ihering (1907) relegated the same specimens as *A. farinosa*.

During the 1914 Roosevelt-Rondon Expedition, one specimen with divergent characteristics identified as *A. farinosa* was collected at the mouth of the Rio Castanho and is currently housed at the Museu Nacional do Rio de Janeiro (MN) (E. O. Willis pers. comm.).

Miranda-Ribeiro (1920), in his revision of the Brazilian parrots, described a Mealy Parrot from northern Mato Grosso with an unusual color pattern. He said (translated): "I also saw one (*A. farinosa*) from the mouth of the Rio Castanho, with red at the base of its tail feathers".

Later, *A. farinosa* aberr. *rubricauda* was described by Stresemann (1924) from a captive specimen of unknown origin sent from the Berlin Zoo to the Zoological Museum in Berlin (ZMB 23160). Despite the red base of its tail feathers, Stresemann considered it an aberration. Pinto (1935) and Pinto and Camargo (1954) also commented that two female *A. farinosa* collected by Garbe at the Juruá river (MZUSP 2727 and 3478) had red on their tail feathers, but attributed that character to individual, and age variation. Like Stresemann and Miranda-Ribeiro, Pinto (1935) Pinto and Camargo (1954) did note notice other distinctive characteristics in the museum specimens. Although the distinctive tail coloration of *Amazona kawalli* had been already noticed many decades ago, its diagnostic value was not recognized, because other key morphological characteristics of the taxon, like soft parts, structure, and color, were not noticed in museum skins.

Some of these distinctive Mealy Parrots were also pictured several times up to the early 1980's. Sick (1961), photographed a captive specimen identified as *A. farinosa* at a Munducurú indian village, on the right bank of the Cururú river, in the foothills of the Serra do Cachimbo, Pará state. Bosch and Wedde (1984) also pictured a captive bird identified as *Amazona farinosa inornata*. Both pictures clearly show an Amazona with a large white skin patch at the base of the bird's mandible and a dark eye-ring, both characters not present in typical Mealy Parrots.

The answer for the problem of aberrant Mealy Parrot came in the middle 1980's, when Nelson Kawall, an experienced Brazilian aviculturist, received a few unusual *Amazona* individuals, said to come from the lower Tapajós River. Kawall's discovery led to the description of *A. kawalli* (Grantsau and Camargo 1989). According to the description, nine characters distinguish *A. kawalli* from *A. farinosa*, the main ones being a bare white skin patch at the base of the lower mandible, exactly like the birds pictured by Sick (1961) and Bosch and Wedde (1984), and the red base of the tail feathers. The original description was based on Pinto's red-tailed "*farinosa*" specimens from the Juruá river, one former captive specimen from Grantsau's collection (RG 7577 - paratype), and two live birds in Kawall's collection. Grantsau and Camargo (1989) also mentioned another specimen, (Museu Paraense Emilio Goeldi MPEG 14804), said by them to come from Santarém, Pará, but this was not used in the species description. None of the known specimens has precise locality data, except for the two MZUSP specimens and the MPEG bird, which was actually collected by J. Hidasi on 7 November 1955 at Itaituba, Pará (Oren and Parker, in press), and not Santarém as pointed by Grantsau and Camargo (1989). Grantsau and Camargo (1990) republished the 1989 description, with the addition of a table of measurements of *A. kawalli* and a map plotting the distribution of *A. kawalli*, showing two localities 1,700 km apart.

The species' validity has not been unanimously accepted. Bosch (1991) and Parker *et al.* (1996) considered *A. kawalli* an individual variation of *A. farinosa*. Teixeira (pers. comm. 1993) was the first to mention the specimen described by Stresemann, which he assumed to be a Mealy Parrot identical to *A. kawalli*, and concluded that the later taxon is not valid. He noticed that the diagnostic characteristics of *A. kawalli* occurred singly or simultaneously in several *A. farinosa* specimens he examined. The mandible skin patch was considered to be of no diagnostic value, because it almost disappears in prepared skins, and similar-looking skin folds could be observed in museum skins of *A. farinosa* and even in some Orange-winged Parrots *A. amazonica*.

The name validity has caused controversy. After the

description by Grantsau and Camargo (1989), Teixeira (pers. comm., 1993) not considered the name *kawalli*. Collar and Pittman (1996), studying the type of *rubricauda* designed by Stresseman found that *kawalli* must prevail over *rubricauda*.

Vuilleumier *et al.* (1992), commenting on new species of birds described from 1981 to 1990, considered that more information was needed to prove the validity of *A. kawalli*. They said: "We feel that there is no evidence at present to decide what the status of this form is, hence our classification as *Species Inquirendae*". Nevertheless, Sibley and Monroe (1993) included this species in their review of the birds of the world. Also, several publications have mentioned the species, without offering new data (Low 1990, 1992, Arndt 1991, Bosch 1991).

More recently, cytotaxonomic analysis of Brazilian species of the genus *Amazona* made by Duarte and Caparroz (1995) found differences between *A. kawalli* and *A. farinosa* in chromossomes two and three.

In this paper we report the discovery of free-living parrots agreeing with the description of *A. kawalli*, describe their habitat, distribution, voice, aspects of their ecology, and population status, and we evaluate their taxonomic status.

METHODS

Three expeditions were made in search of *A. kawalli*, the first two to Apiacás Ecological Station (approximately 8°20'S, 57°40'W), northern Mato Grosso state, during a Rapid Assessment Program (RAP) to generate data to subsidy the station's management plan. The expeditions were made from 22 July to 15 August and 28 October to 12 November 1995 on the lower courses of the Rio Teles Pires and Rio Juruena, and the upper reaches of the Tapajós river. The third expedition was from six to 20 March 1996, when we explored the Tapajós river from the town of Itaituba to the junction of the of the Rio Teles Pires and Rio Juruena, including some of its tributaries (figure 1).

The species' distribution was assessed by visiting localities with seemingly suitable habitat, as suggested on localities where we had previously observed the species, and also adjacent areas harboring different plant communities.

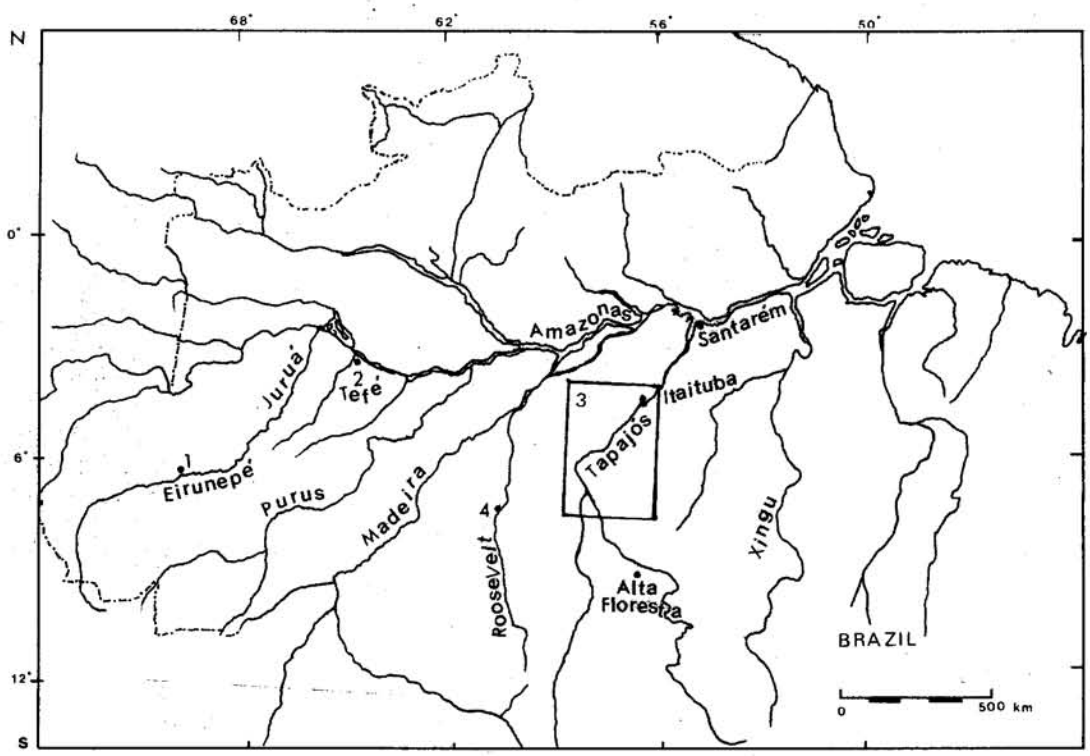
Amazona parrots were detected by walking transect lines cut through natural vegetation patches, and we also made boat transects along the rivers. The transects were surveyed daily from early morning (05:30) until after sunset (18:30). Every parrot observed or heard during this time was recorded, along with additional data na group size and habitat type (Semideciduous Forest, Terra Firme Forest, Floodplain Forest, Buritizal, and Campinarana or sand-ridge woods); habitat categories follow RADAMBRASIL (1975). Whenever a group of *Amazona* was observed perched or feeding, group size, number of juveniles, plant food species, part eaten (flower, seed, fruit, pulp or whole fruit), and general behavior. Each time a group was found eating, we recorded a feeding bout. Different groups congregating at a food source could generally be separated as they arrived or departed. One feeding bout was recorded for each group. We considered only the instances when birds were definitely seen feeding, and discounted indirect evidence and second-hand reports.

During the three field expeditions, the distribution and population size of *A. kawalli* was assessed through searches throughout the riverine areas in the headwaters of the Tapajós river and its tributaries (figure 1). In areas where the species was located, local populations were censused at night roosts. We made at least one count at each roost. During censuses, the direction of flight of birds arriving at and departing from a given roost was the same for all birds, although they did not all arrive and depart at the same time. This direction was recorded and assumed to indicate the location of the general foraging areas of each group of parrot population. We used this information to establish ranges and to identity different populations. During censuses we also counted family groups (adults and juveniles) to estimate recruitment. Juveniles were easily identified when flying with their parents, keeping with them but always somewhat behind.

To estimate the relative abundance of *A. kawalli* populations, transects were conducted following the techniques of Ralph and Scott (1981,1993). Total transect distances, measured *in situ* or taken from maps, were 77 km overland and 180 km by boat in July-August 1995, 68 km overland and 110 km by boat in October-November 1995, and 64 km overland and 435 km by boat in March 1996. In all, we walked 47 km at about two km/hr, through Semidecidous Forest, 38 km in Terra Firme Forest, 30 km in transitional habitats between Terra Firme to Floodplain forests, 42 km in Floodplain Forest, 23 km in Campinarana, seven km in Buritizal, 22 km in disturbed areas, and 725 km along rivers by boat. Transect width was about 100 m in Semidecidous Forest, Terra Firme Forest, Buritizal, and Foodplain Forest. In Campinarana the transect width was 150 m. Boat transects, conducted at speeds of five-eight km/hr, detected *Amazona* flying overhead or perched only along the margins.

Tape recording of *Amazona* calls were made with a Sony TCN 5000EV cassette-recorders and a Sennheiser 80-E directional microphone, and were analyzed with a UNISCAN II digital sonograph at the Laboratory of Bioacoustics of the Universidade Estadual de Campinas-UNICAMP. We made comparative analyses of the "flight call" of *A. kawalli*, because this call has been considered a species-specific character among *Amazona* parrots (Vielliard 1994). Voucher recordings of *A. kawalli* were deposited in the "Arquivo Sonoro Neotropical" (ASN) at the Universidade Estadual de Campinas, and in the Libary of Natural Sounds, Cornell Laboratory of Ornithology.

Breeding data were obtained through partial monitoring of two nests. Another five nests were discovered at different stages of the breeding cycle, and for these, the habitat, species, genus and size of the nest tree, height,



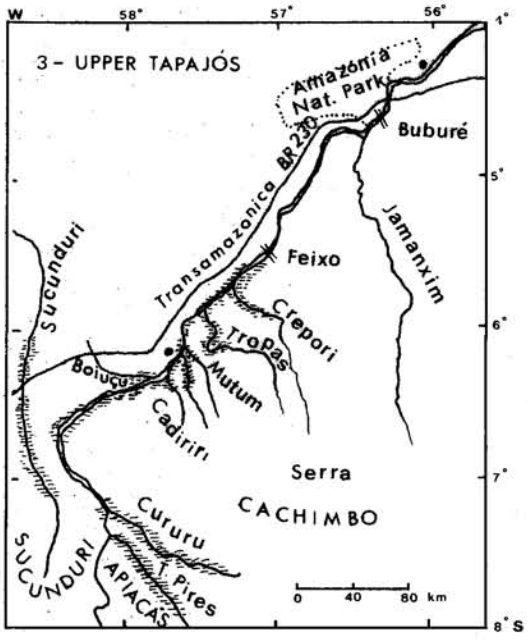


Figure 1. Above. The distribution of *Amazona kawalli* in Amazon region, Brazil. Numbers by locality points (1-Eirunepé, 2-Tefé, 4- mouth of Rio Roosevelt) were based on records in the literature and museum specimens. Bellow. Detail of the upper Rio Tapajós study site, shows the distribution of flooded forest based on RADAMBRASIL (1975).

number of eggs or nestlings, were recorded.

Specimens (collection abbreviations in appendix) of *A. kawalli* (N = 8) and *A. farinosa* (N = 33) at MZUSP, MPEG, Museu Nacional do Rio de Janeiro (MN), Roberto Antonelli Filho collection (RAF), and Rolf Grantsau collection (RG) were examined and measured with calipers to the nearest millimeter. Measurements taken were wing and tail length, culmen (from bill tip to cere), bill width, bill height, bill tip to tooth, tooth to base of upper mandible, and width, height, length and chisel width of the lower mandible (table 1). The morphology and characteristics of nestling and adult *A. kawalli* were observed from 22 chicks of several ages taken from their nests by Mundurucú Indians, and 78 adult *Amazona* kept as pets by local people. We analyzed the measurement data with *t*-test (SAS Institute, Inc. 1988) that compared the mean differences and s.d. of variables between *A. kawalli* and *A. farinosa* (table 1).

To evaluate the extent of the species' habitat, we used the methodology described by Sobrevila and Bath (1992), standard for Rapid Ecological Assessments, a survey methodology for unstudied ecosystems with previous satellite maps (Landsat TM5, scale 1:100,000) defined as different habitat characterization types. The field multidisciplinary survey team check each of previous defined habitats with same effort. Nineteen flight hours were spent, doing aerial surveys by airplane over the entire region between the mouth of the Rio Juruena and Rio Teles Pires and headwaters of the Rio Tapajós.

RESULTS AND DISCUSSION

Distribution and habitat. We found *A. kawalli* in northernmost Mato Grosso (known as Pontal Matogrossense) at the border with Pará and Amazonas states, along the lower reaches of the Rio Teles Pires and the Rio Juruena, and in the headwaters of the Rio Tapajós and its tributaries: Rio das Tropas, Rio Creporí, Rio das Almas, Rio Preto, Rio Cururú, Rio Mutum, Rio Pacú, Rio Saicinza, Rio Cadiriri, Rio Cabitutu, and Rio Buiuçú (figure 1). The species was observed as far north as Feixo, on the Rio Tapajós, 200 km upstream from Itaituba (figure 1). Feixo is a 200 m-high, rocky massif cut by the Tapajós (from 4°40'767''S and 56°42'693''W to 4°58'830''S and 56°46'776''W) along a 38 km steep-walled valley with no floodplain. The southern limit of distribution is the Serra dos Apíacás (peaking at 350 m a.s.l.), an eroded Pre-Cambrian quartzite range cut both by the Rio Teles Pires and Rio Juruena at 9°S. This range marks na area of major ecological change, because its sandy, poor soils support a low, savanna vegetation belt 200 km wide. Similar disruption occurs west and east of the Pontal region, where another two Pre-Cambrian massifs (Sucunduri, 350 m-high; and Cachimbo, at 650 m the highest massif in the region) form areas of much drier habitat that in a way surround the mesic, forest-covered basins of the Rio Juruena, Rio Teles Pires, and upper Rio Tapajós (RADAMBRASIL 1975).

The distribution of the *A. kawalli* was associated to certain plant communities, most of which were contained in Floodplain forests. Overall, *A. kawalli* is fairly easily found wherever there is Floodplain Forest along the lower reaches of the Rio Teles Pires, Rio Juruena, and the upper Rio Tapajós, and their tributaries, down to the town of Jacareacanga. This region includes the main areas of floodplain forest along Rio Tapajós and its tributaries (RADAMBRASIL 1975, Oliveira *et al.* 1993). Downstream from Jacareacanga city the floodplain forest is replaced by Semidecidous Forests and Upland Forests growing in the Pre-Cambrian massif, appearing again only about 300 km downriver where its waters meet the Amazonas river. The region forms the headwaters of the Rio Tapajós, a typical clear-water river, with low to medium productivity. Rapids and waterfalls form a line along the border between the Central Brazilian Shield and the Amazon Basin (RADAMBRASIL 1975).

Yellow or red latossols predominate in the region, associated in well drained, but still humid, lower areas with Terra Firme Forests, the tallest forest found in the area. On the slopes, due to better drainage, a Dry Forest grows. Over shallow, stony, and extremely poor soils atop the hills one finds savanna communities dominated by species with xeromorphic adaptations. Riverine terraces, formed by deposits of material carried by large rivers, form a special habitat. They are found in the lower, seasonally flooded areas at 80-100 m asl. Those terraces, when made of quartzite sands, support patches of low Campinarana vegetation, whereas seasonally flooded forest grows over clay or silt deposits (Prance 1976).

The region harbours a complex mosaic of different vegetation types rarely matched elsewhere. The following five vegetation types may be distinguished in the field, although ecotones between them add further heterogeneity. More detailed informations about floristic composition are present by Prance (1980), Pires and Prance (1985), and Rodrigues (1996).

Upland Evergreen Forest (Terra Firme Forest) has a multilayered closed canopy 30 m high, (tallest trees over 35 m), with *Bertholletia exelsa* (Lecythidaceae), *Dinizia excelsa* (Leguminosae), *Pouteria* sp. (Sapotaceae), *Euterpe precatoria, Astrocaryum vulgare,* and *Bactris gasipaes* (Palmae), all of which are abundant. Other representative species are *Hevea brasiliensis* (Euphorbiaceae), *Manilkara* sp. (Sapotaceae), *Parkia pendula* (Leguminosae), *Protium* sp. (Burseraceae) and cocoa trees *Theobroma cacao* (Sterculiaceae). Vines (mainly *Philodendron* spp.) and lianas are common on the largest trees.

Upland Semidecidous Forest (Dry Forest) has a open canopy reaching 25 m, with occasional emergents reaching 40 m with trunks three m in girth. The predominant tree species is *Ceiba petandra* (Bombaceae). Others characteristic tree species are *Hymenaea courbaril* (Leguminosae), *Hura crepitans* (Euphorbiaceae), *Vochysia* sp. (Vochysiaceae), and *Tabebuia* sp. (Bignoniaceae). The

Table 1. Body and bill measurements (mm) of *Amazona kawalli* and *Amazona farinosa*; see text for discussion.

Species	Sex	N*	Wing length	Tail length	Culmen length	Width upper mandible	Heigth upper mandible	Tip/Tooth distance upper mandible	Base tooth lower mandible	Width lower mandible	Heigth lower mandible	Length lower mandible	Chisel lower mandible
Amazona farinosa	F	(10-8)	237.8 (SD=8.8)	122.7 (SD=11.0)	37.5 (SD=1.7)	20.5 (SD=0.5)	20.0 (SD=0.6)	14.4 (SD=1.0)	20.4 (SD=2.2)	24.0 (SD=0.7)	18.3 (SD=0.7)	21.9 (SD=0.8)	9.9 (SD=0.8)
	M	(23-11)	248.4 (SD=7.7)	127.4 (SD=8.3)	38.7 (SD=3.0)	21.3 (SD=0.9)	20.1 (SD=0.7)	15.2 (SD=0.9)	21.3 (SD=1.3)	24.8 (SD=1.4)	19.6 (SD=1.3)	22.6 (SD=1.6)	10.0 (SD=0.7)
		Pooled	245.2 (SD=9.4)	126.0 (SD=9.5)	38.3 (SD=2.7)	21.09 (SD=0.8)	20.1 (SD=0.7)	15.0 (SD=1.0)	21.0 (SD=1.7)	24.5 (SD=1.3)	19.2 (SD=1.3)	22.5 (SD=1.5)	10.0 (SD=0.7)
Amazona kawalli	F	(5-3)	247.6 (SD=10.5)	122.4 (SD=10.9)	37.0 (SD=1.6)	18.3 (SD=0.5)	18.6 (SD=0.4)	12.8 (SD=0.6)	19.3 (SD=1.1)	22.7 (SD=1.3)	15.7 (SD=1.4)	20.6 (SD=0.9)	9.5 (SD=0.1)
	M	(2-2)	250.0 (SD=11.3)	133.0 (SD=15.5)	37.0 (SD=3.8)	18.5 (SD=0.4)	19.5 (SD=1.3)	12.2 (SD=1.2)	18.0 (SD=2.9)	23.0 (SD=1.9)	16.8 (SD=0.0)	22.1 (SD=0.6)	9.5 (SD=1.5)
		Pooled	248.2 (SD=9.8)	125.4 (SD=12.1)	37.1 (SD=2.0)	18.4 (SD=0.5)	18.9 (SD=0.7)	12.6 (SD=0.7)	18.9 (SD=1.6)	22.8 (SD=1.3)	16.0 (SD=1.3)	21.0 (SD=1.0)	9.5 (SD=0.6)
t - test**			t=0.75 p>0.20	t=0.14 p>0.20	t=3.83 p>0.01	t=7.55 p>0.001	t=3.96 p>0.01	t=5.55 p>0.001	t=3.96 p>0.01	t=3.00 p>0.01	t=5.60 p>0.001	t=0.87 p>0.20	t=1.63 p>0.10

* Sample sizes in parentheses (total specimens – total localities).

** Paired Student's *t-test* comparison of means for *A. kawalli* and *A. farinosa*.

palm *Orbygnia speciosa* is common, some reaching 18 m. Lianas and epiphyties are also common. This habitat is found mainly along the Rio Juruena.

Seasonally Inundated Evergreen Forest (Floodplain Forest) is an evergreen formation growing on quartzitic sand deposits along the rivers. This forest borders the rivers in bards up to 300 m wide. The canopy (20-25 m high) is usually continuous and dense, with a few more open patches. *Inga* sp. (Leguminosae), *Macrolobium acaecifolium*, *Pithecelobium racemosum* (Leguminosae), and *Tapirira guianensis* (Anarcadiaceae) are abundant. There are many microepiphytic species and lianas. This forest remains flooded from November to March or April.

Campinarana (Sand-ridge wood) is a community that grows on quartzite sandy soils not subject to flooding. It has a sparse ground cover, with 30-cm-high grass clumps, interspersed with bare soil. A dense cover of low trees, two-four m high, characterizes this formation. Trees reaching up to seven m are occasionally found. This formation is found mainly on the Serra dos Apiacás, the Sucundurí massif, and the Cachimbo massif.

Palm Forest is an almost monospecific formation entirely dominated by *Mauritia flexuosa* in wet soils, or by *Orbignya martinica* and *Oenocarpus bacaba* in dry soils. This formation occurs patchily amid other forest types.

Climate in the region is seasonal. The average annual precipitation is approximately 2,500-2,800 mm. The rainy season extends from November to March, with the peak in February with na average of 450-550 mm. During the wettest period, mean temperature ranges from 23°C to 26°C, and relative humidity from 90 to 95%. The dry season lasts from June to September, with less than 100 mm of rain per month. August is the driest month, with almost no precipitation. Differences in the levels of the rivers can be marked between the dry and rain season, with up to four m recorded from water marks on seasonally flooded forest trees (RADAMBRASIL 1975).

The distribution of Floodplain Forests along the Rio Tapajós and its tributaries correspond with the highest rainfall isolines on the southern Amazonian forests (2,500-2,800 mm) (RADAMBRASIL 1975, Uhl *et al.* 1990). From the middle Rio Aripuanã to the upper Rio Tapajós (Madeira-Tapajós center, Cracraft, 1985), the main Floodplain Forest areas occur south of the Amazon. Outside this isoline, rainfall is lower and semideciduous vegetational zones occur between the Tapajós-Xingu and Aripuanã-Madeira rivers. Indicative of this replacement, Mahogany *Sweitenia macrophilla* (Melliaceae) a typical species of semideciduous forests, occurs in isolines below 2,000 mm. (RADAMBRASIL 1975, Oliveira *et al.* 1993) and was not recorded by us at the headwaters of the Tapajós.

Group size and population densities. We made 86 sightings of *A. kawalli* in 32 field days (27 in the first expedition, three in the second and 56 in the third expedition), totaling 168 individual records. *A. kawalli* were in pairs or small flocks. Flock size in August ranged from one to eight, whereas in October-November ranged from two to six parrots. In March 1996, flock size ranged from one to two parrots. Differences among expeditions are due to the fact that activities in the second period were concentrated at the Rio Juruena valley, na area dominated by Semidecidous Forests, where the species does not occur (see below). We found *A. kawalli* in the Rio Juruena valley only near its junction with the Rio Tapajós, a transitional area between Semidecidous Forest and Terra Firme Forest (RADAMBRASIL 1975). During the March 1996 censuses the *A. kawalli* were breeding and seen only in pairs.

No *A. kawalli* was observed along 23 km of Campinarana transects neither along the seven km in Buritizal forest. Also, none was observed along 22 km through secondary vegetation and logged forest. In Semidecidous Forest along the Rio Juruena, we surveyed 140 km by boat, finding three parrots (0.3 ind/sq.-km). No *A. kawalli* were observed along 47 km of foot transects in the same area.

In 38 km surveyed in Terra Firme Forest, we found eight parrots (2.1/sq.-km). In 30 km of transitional habitats between Terra Firme and Floodplain Forests, we found 18 parrots (6.0/sq.-km). In the Floodplain Forest we walked 42 km, finding 74 parrots (17.6/sq.-km). We also rode 190 km by boat in the same habitat, finding 65 parrots (3.5/sq.-km).

In March 1996 we surveyed 395 km by boat from Itaituba to Feixo (Jacareacanga) along the Rio Tapajós dominated by Terra Firme Forest and Semidecidous Forest, no *A. kawalli* were observed.

The results on surveys along pasture and disturbed areas suggest that *A. kawalli* can not persist or breed in small forest fragments (see under Conservation).

Sympatric Psittacidae species. We recorded 18 species of Psittacidae in the range of *A. kawalli* (Martuscelli and Yamashita, *in prep*). The only other *Amazona* parrot in the region surveyed is the Orange-winged Parrot (*A. amazonica)*, but they do not roost with *A. kawalli* in the communal roosting trees along the Rio Teles Pires or Rio das Tropas. Other Psittacidae species found with *A. kawalli* are listed in table 2.

White-cheeked Parrot was also common in comparison to other Psittacidae of our study sites. Only three (*A. amazonica,* Vulturine Parrot *Pionopsita vulturina,* and Golden-winged Parakeet *Brotogeris chrysopterus*) of the 18 other Psittacidae species in the Rio Tapajós headwaters were more abundant than *A. kawalli* during all observation periods (table 2). *Amazona kawalli* was the only conspicuous species restricted to Floodplain Forest habitat.

We found *A. farinosa* at four localities on the periphery of the range of *A. kawalli* (figure 2): 30 km from Itaituba, on the Itaituba-Transamazonica road; at Parque Nacional da Amazônia (Amazonia National Park), at Buburé Falls; and together with Yellow-headed Parrot *A. ochrocephala* at Alta Floresta, 100 km south of the Serra dos Apiacás; and in the southeastern foothills of the Cachimbo mountains, Pará.

Table 2. Species of Psittacidae sympatric with *Amazona kawalli* at the upper Rio Tapajós. DF-Dry Forest, TF- Terra Firme Forest, AF- Floodplain Forest, CA- Campinarana, PF- Palm Forest. N – total individuals observed of each specie

Species	Habitat					Total
	DF	TF	AF	CA	PF	(N)
Ara chloroptera Red-and-green Macaw	27%	48%	25%			56
Ara ararauna Blue-and-yellow Macaw	89%	8%			3%	75
Ara macao Scarlet Macaw	58%	42%				78
Ara severa Chestnut-fronted Macaw		70%	30%			113
Ara manilata Red-bellied Macaw					100%	112
Aratinga garouba Golden Parakeet		100%				5
Aratinga pertinax Brown-throated Parakeet	100%					45
Aratinga leucophtalmus White-eyed Parakeet		62%	38%			55
Pyrrhura rhodogaster Crimson-bellied Parakeet		100%				15
Pyrrhura picta Painted Parakeet	25%	75%				12
Forpus cf. *sclateri* Dusky-bellied Parrotlet	100%					2
Brotogeris chrysopterus Golden-winged Parakeet	17%	51%	14%	13%	5%	245
Pionites leucogaster White-bellied Parrot	20%	80%				5
Pionopsitta barrabandi Orange-cheeked Parrot		13%	87%			16
Pionopsitta vulturina Vulturine Parrot		44%	56%			176
Amazona kawalli White-cheeked Parrot	2%	14%	84%			166
Amazona amazonica Orange-winged Amazon	14%	30%	56%			459
Pionus menstrus Blue-headed Parrot	20%	47%	33%			115
Deroptyus accipitrinus Red Fan Parrot		33%	67%			6

Literature and museum records of the Mealy Parrot from the region come from Parque Nacional da Amazônia on the Rio Tapajós, upstream from Buburé Falls, 50 km south of Itaituba (Forrester 1993, Oren and Parker *in press*) and from Caxiricatuba (02°50'S, 55°08'W) and Fordlândia (03°40'S, 55°30'W), both on the lower course of the Rio Tapajós, Pará (specimens housed at MZUSP and MPEG). Roth (1984) found *A. farinosa* on the upper Rio Aripuanã, Mato Grosso. Zimmer *et al.* (*in press*) also found *A. farinosa* and *A. ochrocephala* at Alta Floresta.

Diet and foraging behavior. We observed *A. kawalli* feeding on 10 plant species (N = 15 feeding bouts), all restricted to Floodplain Forest and its ecotone with Terra Firme Forest. Most records were seeds (60 %), pulp, fruits, leaves and flowers were also eaten in most instances (table 3).

On one occasion four *A. kawalli* were seen feeding on young leaves of the rubber tree *Hevea brasiliensis* along with eight Painted Parakeets *Pyrrhura picta*. This feeding aggregation was observed in the same spot during three consecutive days. In another instance in the mouth of the Rio das Tropas we observed *A. kawalli* and eight Painted Parakeets feeding on the flowers of *Erythrina* sp. A species with abundant nectar that also attracted other parrots species such as *B. chrysopterus* and *P. vulturina*. The parrots spent a half-hour picking one flower at a tine, chewing around its base, discarding it, and then repeating the process.

Amazona kawalli was never observed feeding near human dwellings, despite the availability of fruiting mango and jackfruit trees. The only Psittacidae observed in those areas were *B. chrysopterus* and Crimson-bellied Parakeet *Pyrrhura rhodogaster*.

We observed *A. kawalli* every day spent in flooded forest on headwaters of Tapajós river, usually flying in pairs or small family groups during early morning and afternoon, its "weeóu" flight call making it conspicuous. Like other *Amazona* (Whitney 1996), *A. kawalli* is noisy, and groups were usually first noticed by its calls. In February, when fledglings were present, their continuous begging was the best clue to located groups.

Amazona kawalli travel in small groups (often in pairs, rarely more than eight birds). Flying *A. kawalli* can be recognized in the field by its shallow wing beat, direct and slow flight. The pairs follow a tight parallel flight path, usually just above the canopy. This characteristic is clearly distinct from *A. amazonica* (the only sympatric *Amazona*), whose flight is rapid and sinuous, usually above the canopy like *Pionopsitta* (Whitney 1996).

Breeding biology. During the July-August and October-November expeditions we found no sign of breeding by *A. kawalli*. We found breeding activity signs of others species of Psittacidae in the headwaters of the Tapajós in early November 1995. On 2 November at the Rio Teles Pires, we observed a flock of 34 *P. vulturina* perched in a tree. Nine were being feeding by their parents and showed their heads colored by yellow, a typical plumage of this species' fledged young birds. On 10 November, we observed two *A. amazonica* searching cavities in Dry Forest along the Rio Juruena, and a pair of Red-and-green macaws *Ara*

Table 3. Species of plant eaten by *Amazona kawalli*. FF: Flooded Forest, TFF: "Terra Firme" Forest

Plant species	Parts eaten	nº feeding bouts	Habitat
Maximiliana maripa	Fruit and pulp	2	FF
Eichelera sp.	Seed	1	FF
Joanesia sp.	Seed	1	FF
Leguminosae *indet*	Seed	1	FF
Inga sp.	Pulp and seed	2	FF
Callophylum brasiliense	Pulp and seed	1	FF
Euterpe oleracea	Pulp	1	FF
Tapirira guianensis	Seed	1	FF
Hevea brasiliensis	Leave	4	TFF
Erytrina sp.	Flower	1	FF

chloroptera had na active nest in a dead *Bertholetia* tree. At Barra de São Manuel, Amazonas state, we found nestlings of *B. chrysopterus* and Blue-headed Parrot *Pionus menstrus* during the same season.

Courtship behavior of *A. kawalli* was observed at the Tropas river on 18 March 1996. At 09:00, after heavy rains, a presumed male (larger and vocalizing more actively) was observed on a 14-m tall legume tree, two m to the side of a small individual. The larger individual vocalized intensely in bouts of 10 sec duration, simultaneously raising its head feathers, opening its tail showing the red feathers, and keeping the wings half-opened. The other parrot seemed indifferent and fed on seed pods. The displaying bird repeated this behavior every two minutes, for a total of 20 min of observation. After that, it approached the female, raised and lowered its head rapidly, started to pick twigs with his bill, vocalized and dropped the twig, before picking another one and starting again to vocalize. The female then called with the male, both flying to the canopy soon after. During three days we observed presumed same pair *A. kawalli* in the same legume tree.

The first active, probably attended the same individuals, nest was discovered nearby on 15 March 1995. The nest hole was in a 10-m tall dead tree in floodplain forest two km upstream from mouth of the Rio das Tropas, near the bank. The hole was about eight m above the water. The nest was discovered at 07:30 due to intensive vocalization of the chicks. Two adults were perched nearby. As the boat goting closer to the nest tree, one parrot flew five m without any vocalization straight toward the nest, while the other one remained perched. With the arrival of the adult, the chicks increased their level noise. A few minutes later, the other parrot flew to the nest hole. At this moment, the chicks stopped calling and one adult emerged from the cavity and perched at its opening.

We found six more nests, all in Floodplain Forest during the wet season (December to April), when the rivers rise four-seven m above normal, flooding their banks. Nest heights ranges from 6.5 to 25 m, and cavity depths ranged from 1.3 to 3.5 m. Five nests were in dead trees, found throughout this seasonally flooded habitat. Only three nest trees could be identified: two *Ficus* sp. and one *Hevea* sp.

We examined 22 nestlings that ranged in age from two-three to 50-55 days old. The youngest nestlings had a dull, creamy white bill. At age 10-15 days, a dark patch appears on the sides of the upper bill, stretching from the nostrils to the bill tip. At age 50-55 days, the patch has grown to cover most of the upper bill, similar to the pattern observed in adult birds, which have na even darker and more extensive patch, except for a lateral area between the tooth and the base of the bill, which remains dull creamy white. The white skin patch at the base of the mandible is already evident in nestling two-three days-old, being more wrinkled and tougher than the surrounding skin. The tongue is pale pink with a black tip, a character also observed in adults. The eye-ring is quite evident by 10-15 days of age, showing a dark gray color also observed in adults. At this age the iris is already red. Also, at this age, chicks show a loral patch densely covered by dark bristles, forming a well-marked area, obvious in the adults. Older nestlings, at 50-55 days, show plumage similar to the adults, with the bases of the outer tail feathers red and no of red at the wing bend. The cere on the fledging is exposed, but becomes partly covered with green feathers with age.

The number of fledged young was estimated during July-August and March 1996. In July–August 14 out of 27 contacts with *A. kawalli* were of pairs followed by young. Eight pairs were observed with one young, five pairs with two young and one pair with three young. During the following period five out of 56 contacts were of pairs with young, four pairs were observed with one young and one pair with two young. During this period most nests were still active with nestlings.

Vocalizations. Like other *Amazona* (Vielliard 1994), *A. kawalli* has a vocal repertoire that includes a stereotyped and loud "flight call" and a large diversity of varied calls. We follow Vielliard (1994) in considering the *Amazona* "flight call", which can be given also when perched, as the acoustic communication signal serving the species-specific recognition function, equivalent to the advertising song of territorial Passerines.

The flight call sounds like "weeóu" and is made of a

single complex note (figure2). The first half of this note is a pure whistle; its frequency rises quickly, and then stabilizes at about 1.6-1.8 kHz. In the second half, seems to be a "double-voice phenomenon" (Greenewalt 1968) in the form of two harmonically unrelated pure whistles: one frequency continues around 1.8 kHz, whereas the other rises up to ca. 2.4 kHz, and then joins the first one in a sharp decrease to c. 1.0 kHz, where they diverge again, one continuing at around 1.0 kHz, the other decreasing to *ca.* 0.6 kHz. This complex structure gives a lower tone and a peculiar timbre to the end of the note. The total duration is about 0.4 s (figure 3 A).

This sound structure has been compared by Vielliard (pers. comm) with the "flight calls" of eight other *Amazon* taxa in the "Arquivo Sonoro Neotropical" (ASN *in* Kettle 1989). Mealy Parrot, Turquoise-fronted Parrrot *A. aestiva,* Orange-winged Parrot, Red-crowned Parrot *A. rhodocorytha,* Vinaceus-breasted Parrot *A. vinacea,* Yellow-faced Parrot *A. xanthops,* Red-tailed Parrot *A. brasiliensis,* and Red-spectacled Parrot *A. pretrei* were discussed by Vielliard (1994). Although this is only a fraction of the species in the genus, it allows us to examined the distinctiveness of *A. kawalli* and to predict its taxonomic relationships because the comparison is being made among homologous species-specific sounds (Vielliard 1995).

The flight call (ASN from Serra do Navio, Amapá state) of *A. farinosa*, the nearest morphological relative of *A. kawalli*, is a composite note with a softly modulated harmonic structure (figure 1 B), different from that of *A. kawalli*. Mealy Parrot appears to form a natural group with *A. rhodocorytha* (but not *A. brasiliensis*), *A. aestiva,* and *A. vinacea* (Vielliard 1994). It is clear at least by call-note structure, that *A. kawalli* does not belong to this species-group. By the unique structure of its double voice, it differs

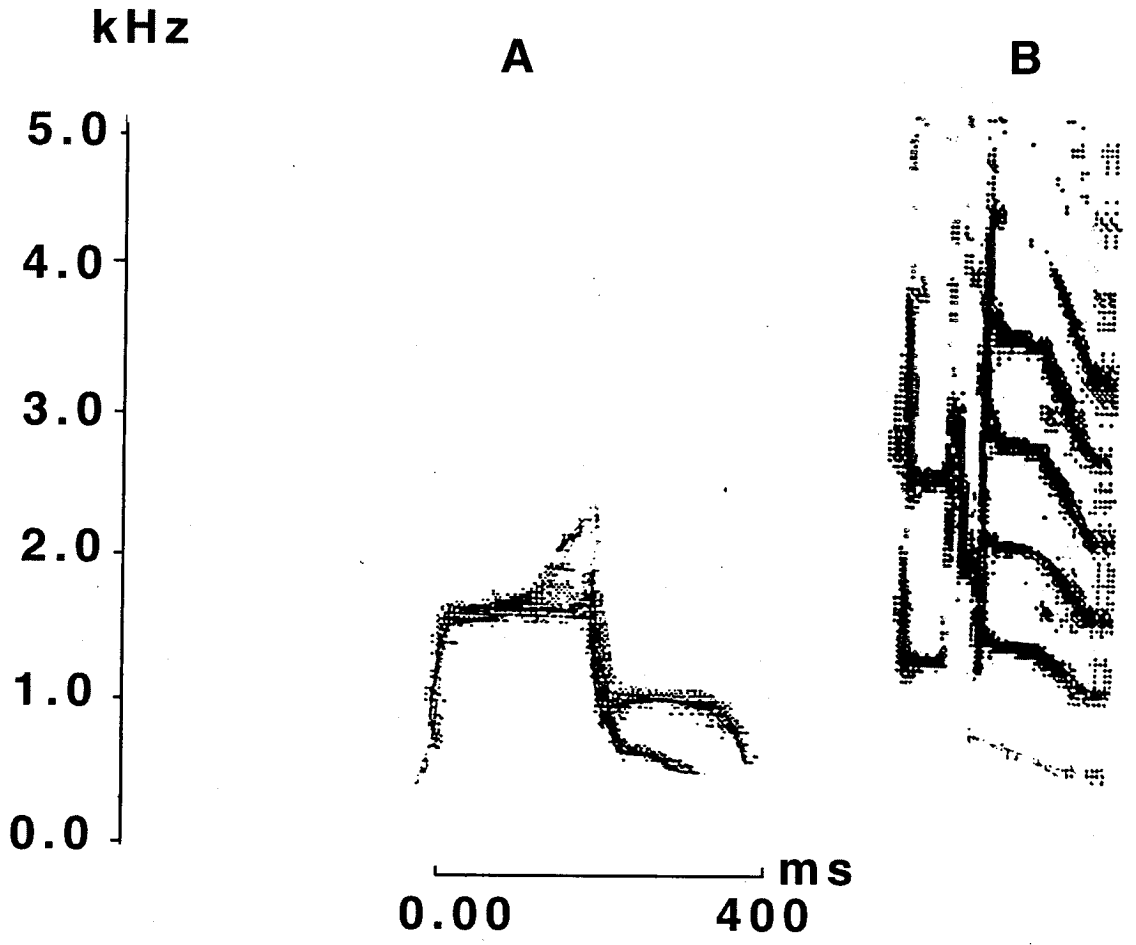


Figure 2. Sonograms of the "flight calls" of: A) *Amazona kawalli* (Rio das Tropas, Pará, Brazil, in ASN) (redrawn from original recording to eliminate reverberation and back ground noise); B) *A. farinosa* (Serra do Navio, Amapá, Brazil, in ASN). Our analysis is based on a long sequence we recorded on 29 November 1995 of a group of two perched birds. In this recording, we selected only the few "flight calls" that we had previously recognized by ear.

from all other *Amazona* studied by Vielliard (1994), and its relationships remain undetermined (Vielliard pers. comm.).

Karyology. Karyotypic analyses has demonstrated a strong similarity among various species of the *Amazona* genus, suggesting great chromosomic conservation in this group (Lucca *et al.* 1991, Duarte and Caparroz 1995).

Cytotaxonomic analysis of Brazilian species of the genus *Amazona* made by Duarte and Caparroz (1995) showed a great similarity of karyotype structure observed among 11 species analyzed (*A. kawalli, A. farinosa, A. aestiva, A. amazonica, A. brasiliensis, A. autumnalis, A. festiva, A. ochrocephala, A. pretrei, A rodocorytha, A vinacea*). A few divergent characteristics in chromosomes two and three among these 11 species led to the spliting of these species in two groups. Chromosome pair three is subtelocentric in *A. kawalli, A aestiva, A. amazonica, A. brasiliensis,* and *A. rodocorytha* and submetacentric in *A. farinosa, A. festiva, A. ochrocephala,* and *A. vinacea.*

Although the karyotypic analysis has demonstrated strong similarity among various species of the *Amazona* genus, the slight differences found by Duarte and Caparroz (1995) between *A. kawalli* and *A. farinosa* is further evidence for treat these two *Amazona* as separate species.

Patterns of plumage and individual variation. During the course of assessment of the relationship of *A. kawalli* with *A. farinosa,* we critically examined all specimens of *A. farinosa* and *A. kawalli* (including the MZUSP 2727 holotype and MZUSP 3478 and RG 7577 paratypes) in Brazilian museums except for the specimens housed at the Museu Nacional (table 1). We found that *A. kawalli* differs significantly from *A. farinosa* in five bill measurements. The most striking result of the analyses of the measurements is the clear-cut separation of *A. kawalli* (at significance level of $p < 0.001$) from *A. farinosa* in culmen length, width of the upper mandible, height of the upper mandible, tip of the bill to tooth length, and distance from tooth to base of the lower mandible (table 1). In general, the bill of *A. kawalli* is disproportionately smaller than that of *A. farinosa*. It also has more heavily keratinized lateral patches on the upper bill. This keratinized area is seen as a thick "plate" with multi-layered defoliating, irregular edges covering the pale patch of the parrot's upper bill. This character is easily observed in both wild and captive adult birds.

We carefully observed 19 different pairs of *A. kawalli* at their nests or flying with their young during the breeding season. One member, probably the male, was always larger. We think that the larger birds are males because we observed a large bird courting a smaller one (see above) and because during observations of pairs, he larger bird spend more time outside the nest, calling, while the smaller one stayed in the nest hole. This sex-related size difference, nevertheless, could not be confirmed from museum specimens. It was not possible to separate *A. kawalli* from *A. farinosa* using tail and wing measurements (table 1). Although captive adults of *A. kawalli* are noticeably larger than *A. farinosa* (pers. obs.), measurements failed to show this in our sample, probably because of its small size.

The most obvious differences between *A. kawalli* and *A. farinosa*, however, lie in plumage patterns and coloration (figure 1): 1- *A. farinosa* of any described subspecies always shows a complete and large white bare eye-ring, whereas *A. kawalli* shows a gray and smaller eye-ring. The eye-ring is already present in nestling *A. kawalli*, but absent from young *A. farinosa* (Whitney 1996); 2- *A. kawalli* has a well developed bristly loral patch reaching the nostrils, whereas only a few *A. farinosa* have scattered bristles. This bristly patch give the face a blackish color, even in nestlings (see Breeding biology); 3- the tongue of *A. kawalli* is light pink with a black tip, whereas that of *A. farinosa* is entirely black; 4- *A. kawalli* is, so far, unique among *Amazona* parrots, in having a bare skin patch at the base of the mandible; 5- The bill of *A. kawalli* (smaller than in *farinosa*) is dark gray with a lateral, dull creamy- white patch, more heavily keratinized, absent from entirely smooth bill of *A. farinosa*; 6- The lateral rectrices of *A. kawalli* are basally red (and displayed by the male when courting the female), a character absent in *A. farinosa*, which belongs to the parrots with no red in their tails (Salvadori 1891, Forshaw 1989, Hoppe 1992); 7- the edge of folded wing is light yellowish-green without the red of *A. farinosa*; 8- general color plumage in *A. kawalli* is brighter than in *farinosa* in live birds, with na emerald hue.

We examined 78 captive *A. kawalli* in its range, most being young one-two years old. Because of the conditions in which they were kept, which probably resulted in abnormal growth patterns, their measurements were not used in this paper. All, nevertheless, showed the same plumage colors and patterns, with the lateral rectrices being basally red, a green wing-bend, a gray eye-ring, red iris, a white skin patch at the base of the mandible, a pale pink tongue with a black tip, and a bristly loral patch. All those characters were constant in the captive individuals, showing no variation.

All *A. kawalli* observed had red on the base of tail, regardless of age (fledglings to adults). Thus, this character shows no ontogenetic change, as pointed by Pinto and Camargo (1954). Also, all other Brazilian *Amazona* species, such as *A. brasiliensis, A aestiva, A. amazonica, A. ochrocephala,* and others, which have the base of tail tinged with red, have this character constant at fledging, and it does not change with age (pers. obs.). Our observations agree with those of Salvadori (1891) that *A. farinosa* does not have red on the base of tail (*contra* Teixeira pers. comm., 1993).

In the wild, when perched in the canopy, the most conspicuous character of *A. farinosa* is the white eye-ring, whereas the most important one of *A. kawalli* is the white patch at the base of the mandible. Perhaps these characters are used by the birds for species recognition. Also, the distinctive contact call, different from any other *Amazona*, is another strong character separating *A. kawalli* from other species.

These constant quantitative and qualitative differences

lead us to conclude that *A. kawalli* is a valid species, not na aberrant *A. farinosa* (contra Bosch 1991, Teixeira pers. comm., 1993, Parker *et al.* 1996). The observed levels of difference are consistent with species-level differences in the Psittacidae (Salvadori 1891, Smith 1975) and support that *A. kawalli* is a full species, somewhat similar to, but distinct from *A. farinosa*.

Museum specimens of *A. kawalli* lose their characteristics of tongue, eye-ring and, sometimes, mandibular skin patch due to skin preparation, although feather colors remain unchanged. Due to these factors, specimens of *A. kawalli* in several museums (MZUSP, MN, MPEG, ZMB, BMNH) were pooled with the similar *A. farinosa*, which, nevertheless, lack all the above characters (N. Kawall, pers. comm.).

Of the seven examined museum specimens of the *A. kawalli*, RAF 1331 shows two central rectrices without the terminal part of the rachis. The type of *A. farinosa* aberr. *rubricauda* (ZMB 23.160) shows 14 rectrizes (Stresemann 1924). Of 78 young individuals of the *A. kawalli* observed (see Introduction), three also had 14 rectrices, one had central rectrizes without raquis on its terminal portion, and three had deformed toes with joined bases, probably a congenital problem.

Taxonomy. Stresemann (1924) described the *Amazona farinosa* aberratio *rubricauda* based on a specimen housed at the Zoological Museum in Berlin (ZMB 23160), which lived at the Berlin Zoo from June 1910 to September 1923. Stresemann noticed that the Berlin specimen had some reddish tail feathers, but he considered this characteristic as a mutation. After Stresemann (1924), Teixeira (pers. comm., 1993) was the first author to consider the name "*rubricauda*" and did not recognize it as a species (see Introduction).

We examined a photograph of the Berlin specimen (ZMB 23160) used by Stresemann (1924) in his description. Based on the photograph and original description, we concluded that *A. farinosa* aberratio *rubricauda* is the same taxon as *A. kawalli* described by Grantsau and Camargo (1989). The Berlin specimen shows clearly a bare skin patch at the base of the mandible, gray eye-ring and basally red lateral rectrices. Despite the brief description, Stresemann's taxon can be easily recognized from the description, as signaled by the name itself note. No other *Amazona* similar in size to *A. farinosa* has red on the tail.

Apart from the Caribbean *Amazona* sp., *A. farinosa* is the only *Amazona* that is up to 38 cm in lenght and up to 600 g in weight. *Amazona* species that show red on their tail, such as *A. amazonica*, *A. ochrocephala*, Scaly-naped Parrot *A. mercenaria*, and *A. brasiliensis*, are smaller than *A. farinosa* (Forshaw 1989, Arndt 1991, Low 1992).

Collar and Pittiman (1996) shows some evidence that *kawalli* must prevail over *rubricauda*, based his conclusion in the International Code of Zoological Nomenclature.

The International Code of Zoological Nomenclature (1985) is not clear with regard to the usage of *rubricauda*, a name that has not been used in the last 50 years, which is a *nomen oblitum*. Nowadays there is a strong trend to consider the *nomen oblitum*, especially the descriptions made before the Nomenclature Code. In our opinion, if *rubricauda* is referable to *kawalli* Grantsau and Camargo (1989), then we suspect that *rubricauda* should be used. If *rubricauda* is valid, and so takes precedence over *kawalli* is a question beyond our scope and better solved by the International Committee of Zoological Nomenclature.

Since the redescription of *A. kawalli* by Grantsau and Camargo (1989), the English name "Kawall's Amazon" (Papagaio de Kawall) has been widely applied (Arndt 1991, Low 1992), regarding to Nelson Kawall's discovery (see Introduction). Sick (1997) applied the name "Papagaio dos Garbes", following Willis and Oniki (1991), in honor of its first collector, E. Garbe (Ihering 1904). Currently, to use a person's name to in the common name of a new species is being avoided by researchers, with morphological and geographical attributes more frequently used. In the headwaters of Rio Tapajós, local people call *A. kawalli* "Papagaio da Cara Branca", meaning "White-cheeked Parrot" (the common name adopted in this paper). The Mundurucú Indians have a specific name for *A. kawalli* as "Puruché" and a generic one "Arú" (Indian language), used for all species of parrots.

Type locality and range. Stresemann (1924) stated that the type specimen of *A. farinosa* aberr. *rubricauda* (ZMB 23160) was a captive bird of unknown origin. Grantsau and Camargo (1989) considered the type locality of *A. kawalli* to be Seringal (rubber plantation) Mato-Piri, by the Rio Juruá close to the city of Eirunepé, Amazonas state, based on the MZUSP specimens and the description of the itinerary of E. Garbe in Ihering (1904). Grantsau and Camargo (1989) also used information from wildlife traders to describe "100 km south of Santarém, on the right bank of the Rio Tapajós" as the locality of one of the paratypes of *A. kawalli* (RG 7577).

During the last 20 years, most *A. kawalli* that appeared in the pet trade came from the bush pilot, Mr. Viê, who lived at Itaituba city, Pará state, but also kept a home at Santarém, both on the southern bank of the Rio Tapajós. Mr. Viê is still remembered by many bird collectors, mostly Indians, throughout the range of *A. kawalli*, where he both transported gold miners and bought live animals to resell. That explains some of the known specimens (like RG 7577) reportedly coming from Santarém or Itaituba, the towns where the dealer operated.

The region of Santarém is relatively well-known to ornithologists (Snethlage 1908, 1914, Pinto 1978, Oren and Parker *in press*), *A. kawalli* being recorded only a few hundred kilometers south of the town (see Distribution and Habitat). Besides the specimen at the MPEG, it has never been recorded at Itaituba or Parque Nacional da Amazônia. Oren and Parker (*in press*) published an annotated list of the birds of the Parque Nacional da Amazônia, based on observations made in the area and over 2,000 specimens collected there and at Itaituba since the beginning of the

century. The only *Amazona* recorded by Oren and Parker (*in press*) in the region were *A. amazonica*, *A. ochrocephala*, and *A. farinosa*.

Aparently the probable *A. kawalli* records error from Santarém by Forrester (1993), Collar and Pittman (1996), that considering it "accidental, with no more than two records since 1960 and hence involves predominantly migrant birds", comes from Grantsau and Camargo (1989) records.

Itaituba is a river port serving boats coming to and from the upper Rio Tapajós. Its airport is also used by small planes coming from gold-prospecting camps at the same area. This town has a FUNAI (National Foundation of Brazilian Indians) office. In this area about 40 Mundurucu Indians live. Many *A. kawalli* are kept as pets in the town (we located 36 in one visit), being brought there by Mundurucu Indians trading the birds or by gold prospectors.

Examining the MPEG *A. kawalli* specimen we found it to be a young bird, as determined by the lack of the keratinized patch at the sides of the bill. That, and the lack of other records of *A. kawalli* from around the town, led us to conclude that the specimen was a former captive.

Fernando Pacheco (pers. comm., Sick 1997) recorded the species five km south of Tefé, southern bank of the Rio Amazonas (figure 2), observing and tape-recording the calls of two individuals. His recordings are virtually identical to ours. Interestingly, Pacheco (1995) found four sympatric *Amazona* (*A. festiva*, *A. farinosa*, *A. amazonica*, and *A. autumnalis*) at Estação Ecológica Mamirauá (Mamiruá Ecological Station), on the northern bank of the Rio Amazonas, only 10 km from where the Tefé record was made. That Mamirauá is one of the largest expanses of Floodplain Forest in the Amazon Basin suggests that habitat is not limiting the occurrence of *A. kawalli* there. Perhaps the southern bank of the Amazonas river is the northern limit of its distribution.

According to F. Pacheco and P. Auricchio (pers. comm., and photographs), *A. kawalli* is found as pets at Tefé, reportedly being captured as nestlings at the mouth of the Rio Juruá, about 300 km downriver from the type locality. Other than Garbe's specimens (Ihering 1904), no *A. kawalli* was recorded at Rio Juruá, despite several surveys carried in this river (Gyldenstope 1945, B. M. Whitney, D. C. Oren and K. S. Brown pers. comm.).

There is one old record of *A. kawalli* from Rio Castanho. During the Roosevelt-Rondon Expedition, one specimen of *A. kawalli* was collected at the mouth of the Rio Castanho on 22 March, 1914. This specimen, housed at Museu Nacional, was identified as *A. farinosa*, and clearly shows the red base of its tail feathers and white skin patch at the base of the bird's mandible (E. O. Willis pers. comm.). According to Naumburg (1930) and Vanzolini (1992), Rio Castanho is a name used by rubber gatherers which reffers to the Rio Roosevelt (07°35'S, 60°20'W).

The Museu Nacional specimen apparently was ignored or overlooked during the description of the birds secured by the Roosevelt-Rondon Expedition and studied by Naumburg (1930). In number 833 of his checklist, Naumburg (1930) pointed: *A. farinosa farinosa*... no specimens were collected. Miranda Ribeiro and Soares (1920), also ignored the MN specimen during the description of the Psittacidae collected by Expedição Rondon in 1908-1916.

Aparently the probable *A. kawalli* record from Rio Castanho (see Introduction) cited by Miranda Ribeiro (1920) is based on the MN specimem and not on a wild observation. According to the itinerary of Roosevelt-Rondon Expedition (Museu Nacional 1943) while Miranda Ribeiro took part (from March 1909 to December 1910), the expedition did not reach Rio Castanho.

There is no record of the *A. kawalli* south of the Serra dos Apiacás (figure 2). Novaes (1976) and Roth (1984) at the Rio Aripuanã, Zimmer *et al.* (*in press*) at Alta Floresta, Novaes and Lima (1991) at the Rio Peixoto de Azevedo, and Pinto and Camargo (1957) at Serra do Cachimbo, found only *A. farinosa*, *A. amazonica*, and *A. ochrocephala*. The Serra dos Apiacás also acts as a limit between subspecies of the Painted Parekeet *Pyrrhura picta* complex. *Pyrrhura picta amazonun* occurrs in the headwaters of the Rio Tapajós in sympatry of *A. kawalli*, where as *P. picta microtera* is found at Alta Floresta, Mato Grosso state, about de 250 km away (Martuscelli and Yamashita, unpubl. data.). This suggests that the Serra dos Apiacás, covered by savanna and campinarana vegetation, is a natural ecological barrier limiting the southmost distribution of *A. kawalli*. The reasons for the distinctness of the avifauna of river-created habitats are probably both ecological and historical. One ecological factor is the enormous difference in habitat structure between terra firme forest and all river-created habitats (Remsen and Parker 1983)

Amazona kawalli and *A. farinosa* are similar size. That they have never been observed in the same areas suggests habitat segregation. *Amazona farinosa* is a typical Terra Firme species (Remsen and Parker 1983, Roth 1984, Forshaw 1989, pers. obs.). During the last years, of the nine nests of *A. farinosa* we found in Rondônia, Amazonas, and São Paulo states, all were in terra firme forest (pers. obs.), whereas *A. kawalli* nests in flooded forest. *Amazona festiva* and *A. brasiliensis* are the only species besides *A. kawalli* to nest in hollow trees over water and preferring flooded forest as breeding habitat (Forshaw 1989, Arndt 1991, Martuscelli 1995, pers. obs.).

One must consider that the distribution of floodplain forest along the Rio Tapajós headwaters is not continuous, with large gaps, the above being a maximum value (see distribution). During our field work at the Tapajós headwaters, we found many species restricted to river-created habitat (Remsen and Parker 1983), such as Amazonian Umbrellabird *Cephalopterus ornatus*, Bare-necked Fruitcrow *Gymnoderus foetidus*, Slate-colored Hawk *Leucopternis shistacea* and Long-billed Woodcreeper *Nasica longirostris*. The caiman lizard *Crocodilurus lacertinus*, which extended its distribution more than 600 km. Two new taxa of marmosets (*Callithrix*

mauesi and *C. saterei*) have been described during recent years from the Rio Aripuanã-Tapajós area. This region has the greatest diversity of Callithrichidae in the Amazonian region. The river-created habitat restricted to the Middle Rio Aripuanã - Upper Rio Tapajós, surrounded by upland forest, have the structural habitat complexity with many lianas and epiphytes that can explain this high richness of marmosets (Rylands *et al.* 1993), and this region is also home for *A. kawalli*.

Conservation. Several factors have negatively influenced the population of *A. kawalli*. Hunting and trade are the most immediate threat to its survival. We found signs of human perturbation in every locality visited. These ranged from obvious signs of logging, gold-mining, and slash-and-burn agriculture to the absence of *A. kawalli* from areas of seemingly suitable habitat near settlements and Indian villages. We suspect that this absence to be due to hunting pressure both by indians and gold-prospectors.

Local people consider large macaws (Scarlet Macaw *Ara macao*, *A. chloroptera*, and Blue-and-yellow Macaw *A. ararauna*) and large *Amazona* (*A. kawalli*) to be preferred game, second only to the cracids. The meat of *A. kawalli* is considered tastier and more palatable than macaw meat. Hunting has severely depleted the populations of the larger parrots which are now abundant only far from settlements. Areas used by indians or gold-miner as camps years ago still have very small or no macaw and *A. kawalli* populations. Local indians, who depend partly on hunting for their subsistence, use firearms, enabling them to have, together with gold-miners, a heavy impact on the *Amazona* and *Ara* populations. Depletion of Psittacidae populations by subsistence hunters has been also reported by Thomsen and Brautigan (1991).

Local people also have a strong tradition of keeping *Amazona* parrots as pets. During the last expedition to the area, we saw 150 nestlings of *A. kawalli* being offered for sale, mostly supplied by indians. Nest trees are usually felled, resulting in the destruction of nesting areas and often killing nestlings. The mortality of young parrots kept as pets is very high. During this study we found no pet *A. kawalli* older than two years. Because the total population of the species is probaby small, such commerce must be considered a serious threat to it.

Others threats include gold and tin mining which destroys large areas of *A. kawalli* habitat. On 1960, 30 km upper the mouth of the Rio das Tropas, a place named Maloquinha was colonized by tin miners, in Pará State, and now represents one of the biggest Cassiterit bed in the Brazilian Amazon (Santos 1981). Because tin mining totally destroys a river's border, it effects flooded forest downstream, the main habitat of *A. kawalli*.

For the 1980's 50,000 km² on the Medium Rio Tapajós, corresponding to the "Auriferous Province of Medium Tapajós River", was known to be the largest Brazil gold mining region (Santos 1981). The number of miners believed to live and work there was about 35,000. Until now almost all of the region's rivers (mainly Rio das Tropas and Rio Creporí, see Distribution) have been dredged, and extensive forests along the rivers' courses destroyed by mining. This also happened in the headwaters of the Rio Tapajos, the Rio Juruena, the Rio Teles Pires and Rio Cururú, where about 10,000 miners lived (Santos 1981).

If is unlikely that *A. kawalli* will receive protection soor. Agricultural settlements and hydroelectric projects are being planned in its remain habitat. Between the Rio Teles Pires and the Rio Cururú in Pará state, 150,000 ha are being planned to serve as an agricultural settlement.

Three dams along the Rio Tapajós (at Buburé Falls, Feixo, and mouth of the Rio Cururú) and another at the lower course of the Teles Pires are planned (CEDI 1996). These projects will flood a huge area and will change the hydrological patterns of the river, which will destroy an estimated 90 % of the total extent of habitat of *A. kawalli* on the upper Rio Tapajós. Alteration of seasonal water flow patterns that would destroy these habitats could potentially exterminate 64 species of Amazonian river-created habitat specialists (Remsen and Parker 1986).

The known extent of the habitat used by *A. kawalli*, based on the distribution of Floodplain Forest, stretches for 910 km along the lower Rio Teles Pires, Rio Juruena and headwaters of Rio Tapajós and its tributaries. For the Tapajós basin, the Floodplain Forest forms a belt of variable width, averaging 150 m. Based on available maps (RADAMBRASIL 1975) and satellite imagery (Landsat, figure 4), there is at most 136,500 ha of Floodplain Forest in the region. The areas occupied by the species on the southern bank of the Rio Amazonas, at the Rio Juruá and the Rio Roosevelt remain to be surveyed. According to RADAMBRASIL (1975) floodplain forests along the Rio Sucunduri and Rio Abacaxis in Amazonas state are extensive, these being potential sites for the species.

The only protected area where *A. kawalli* occurs is the 110,000-ha Apiacás Ecological Station, at the confluence of the Rio Teles Pires and Rio Juruena. This small reserve is, nevertheless, still a "paper park" waiting to be implemented.

About 60 % of the known range of the *A. kawalli* is in Munducurú indian reservation at Pará state. The total Munducurú population is a 5,617 people (CEDI 1996, FUNAI pers. comm.). Considering their hunting activities and their hole on regional trade of living animals, these reservation offers no assurance of protection for the species.

The headwaters of the Rio Tapajós are a "corner" of distribution on many bird species and one of the least-know region in the Amazon (Oren and Albuquerque 1991, Haffer 1992, Oren 1992). Surveys of the Amazonian Forest have been conducted mostly along the main river systems. Only after the 1970's have a few roads like the Transamazônica and the Cuiabá-Santarém highways crossed large portions of Highland or "Terra Firme" forest making accessible the tributaries with poor navigational possibilities and may rapids and waterfalls. Several endemic taxa such as Golden-crowned Manakin *Pipra vilasboasi*

Figure 3. LANDSAT 1994 satellite imagery of Upper Rio Tapajós, Amazon basin, Brazil, showing the extend of *Amazona kawalli* habitat. The arrows shows the meandering course of the Rio Cururú, a typical floodplain river. The dark gray is upland forest "Terra Firme" and Dry Forest. The white color represented Campinarana and bare sands areas.

and Tapajós Brown-throated Parakeet *Aratinga pertinax paraense*, are restrict to the headwaters of Rio Tapajós and Rio Cururú (Sick 1959a, 1959b, Haffer 1992). Except for Sick's bird collection, made in the 1950's, little information about these species is available. Recent ornithological surveys of Floodplain Forest in Rio Tapajós headwaters revelated the existence of 352 bird species (Martuscelli, unpubl. data). Poorly know Amazonian species such as Golden Parakeet *Aratinga guarouba*, White-browed Hawk *Leucopternis kuhli*, Crested Eagle *Morphnus guianensis*, White-tailed Cotinga *Xipholena lamellipenis*, and Amazonian Umbrellabird *Cephalopterus ornatus* were recorded in this region.

From the available knowledge, *A. kawalli* can be considered, at least, a vulnerable species (IUCN 1994), perhaps even qualifying for endangered status, depending on the status of populations probably occurring between the Rio Roosevelt-Rio Tapajós and Rio Juruá. Further pressure on this species such as increased international traffic caused by the bird becoming popular in aviculture, as happened with other *Amazona* species, may add to this species' problems in the near future if effective measures are not taken to protect the wild populations and to avoid smuggling from Brazil.

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APPENDIX

The following specimens were examined. Owing to incomplete growth, damage, only a subset of measurements were included in any given comparison.

Amazona kawalli. Brazil: Rio Juruá, Amazonas MZUSP 3478, 2727 (2 Females - Holotype and Paratype). Pará ? RAF 1331 (1 male). Itaituba-PA ?, MPEG 14804 (1 female). Pará RG 7577, 9097, 9279 (1 male, 2 females). Rio Roosevelt, Mato Grosso MN (s/n).

Amazona farinosa. Brazil: Rio Juruá, Amazonas MZUSP 21012, 20473, 2258, 21001, 21302 (4 males, 1 female). Amazonas, Lago Batista MZUSP 21003, 20930, 20474 (2 males, 1 female). Amazonas, Iguarapé Ambá MZUSP 20563 (1 female). Pará, Capim MZUSP 44039, 44041, 44035, 44038, 44036, 44037, 44040 (5 males, 2 females). Pará, Rio Tapajós MZUSP 44039, 20510, 20566, 21013, 20995 (4 males, 1 female). Pará, Fordlândia MZUSP 58367 (1 male). Pará, Óbidos MZUSP 10617 (1 male). Pará, Belém MZUSP 12807 (1 male). Acre, Rio Iquirá MZUSP 35608 (1 male). Espírito Santo MZUSP 6398 (1 female). Espirito Santo, Rio Doce MZUSP 6731 (1 male). Espírito Santo, Rio São José MZUSP 28648, 28649 (2 males). Bahia, Ilheus MZUSP 33058 (1 male). Bahia, Rio Jucurucú MZUSP 14019 (1 female). Minas Gerais, Rio Matipó MZUSP 10359 (unsexed). São Paulo, São Sebastião MZUSP 11623, 14019 (2 females).