On the Hyacinth macaw's nesting tree: density of young manduvis around adult trees under three different management conditions in the Pantanal wetland, Brazil

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RESUMO. **Sobre a árvore de nidificação da arara azul: densidade de manduvis jovens ao redor de árvores adultas sob três diferentes condições de manejo no Pantanal, Brasil**. A arara azul, *Anodorhynchus hyacinthinus*, é o maior representante dos psitacídeos e está ameaçada de extinção. A maior população da espécie é encontrada no Pantanal. A arara azul possui distribuição relativamente restrita e um nicho ecológico bastante especializado. Cerca de 95 % de seus ninhos, no Pantanal, localizam-se em troncos de manduvi (*Sterculia apetala*, Sterculiaceae), e a disponibilidade de sítios de nidificação pode ser o principal fator limitante para as populações da espécie. O objetivo deste trabalho foi avaliar a densidade de indivíduos jovens de manduvi sob três diferentes condições de manejo no Pantanal. Os resultados sugerem que há uma falha no estabelecimento de novos indivíduos em áreas submetidas à presença de gado e queimadas, o que pode comprometer a conservação da arara azul a longo prazo.

PALAVRAS-CHAVE: *Anodorhynchus hyacinthinus*, arara azul, manduvi, Pantanal, sítios de nidificação, *Sterculia apetala*.

KEY WORDS: *Anodorhynchus hyacinthinus*, Hyacinth Macaw, manduvi, nesting sites, Pantanal, *Sterculia apetala*.

Anodorhynchus hyacinthinus, the Hyacinth macaw, is the largest species of the family Psittacidae, and is threatened by extinction (Bernardes *et al.* 1990). This species is particularly vulnerable because of its low population size, limited distribution and highly specialized niche. The wild population has been estimated at 3,000 individuals (Munn *et al.* 1987). Collar *et al.* (1992) and Abramson and Thomsen (1995) describe the distribution of the Hyacinth macaw in three different areas, almost exclusively Brazilian: eastern Amazonas state, along the border with the state of Pará; north central Brazilian cerrado (part of the states of Piauí, Maranhão, Bahia, Tocantins, Goiás, Mato Grosso and Minas Gerais); and the Pantanal wetland, including part of Bolivia and Paraguay. Most of the Hyacinth macaw population occurs in the Pantanal, and the occurrence of this species in Bolivia and Paraguay is rare (Munn *et al.* 1987, López 1992, Abramsen and Thomsen 1995).

In the Pantanal, the Hyacinth macaw feeds only on the nuts of two palm trees: the bocaiúva *Acrocomia aculeata* (Jacq.) Lodd., and the acuri *Scheelea phalerata* (Mart.) Bur. In the pantanal this macaw nests primarily in only one species of tree, the manduvi *Sterculia apetala* (Jacq.) Karst (Guedes 1995, Guedes and Harper 1995). Between 95-100 % of Hyacinth macaw nests in the south central Pantanal occur in cavities of adult manduvis (Guedes and Harper 1995). Furthermore, only 5 % of adult manduvis in this area contain suitable cavities for the species (Guedes 1993). About 5 % of manduvis with Hyacinth macaw nests are annually lost to fire, deforestation, and/or windstorms, but senescence is also responsible for the loss of nesting sites (Guedes 1993, 1995). The shortage of suitable nesting sites likely constitutes an important limiting factor for this species (Munn *et al.* 1987, Guedes 1993, 1996).

Manduvis are large and fast-growing, canopy or emergent trees, which become established in primary succession or in secondary succession; secondary succession occurs in old fields or small natural clearings in the forest (Janzen 1972). In the Pantanal, the manduvi occurs within patches (capões) and corridors (cordilheiras) of non-inundable semi-deciduous forests (Ratter *et al.* 1988). Surrounding the capões and cordilheiras are seasonally flooded grasslands, much of which is used as rangeland for cattle. During the flooding season (January-June) these forest habitats experience increased pressure from cattle. Additionally, fire used for pasture management commonly enters capões and cordilheiras during the dry season.

The objective of this study was to conduct a preliminary evaluation of the density of young manduvis (seedlings and trees that have not yet begun to produce fruit) around adult manduvis, in three different management conditions. The surveys were conducted at Estação Ecológica Nhumirim (NHU), where cattle have been excluded for more than five years; at Campo Dora Ranch (CDR), where cattle are present throughout the year; and at Baú Ranch (BAU), where cattle are usually present for six months of the year (June to December). NHU is a 600 ha preserve located within the Nhumirim ranch (18°59'S, 56°39'W), a field station of the Centro de Pesquisa Agropecuária do Pantanal (CPAP-EMBRAPA). CDR is a neighboring ranch of 45,000 ha, and our survey was conducted in two pastures comprising about 15,000 ha. Both NHU and CDR are seasonally flooded by local rainfall and the Taquari River. BAU is located south of NHU and CDR (19°19'S, 57°02'W) and is seasonally flooded by the Miranda River.

The point-centered-quarter method (PCQ) (Bonham 1989) was used to determine the density of young individuals around adult manduvis. In each study area, 10 adult manduvis were located and used as centerpoints. The height, basal diameter (taken at a height of 10 cm), and distance to the centerpoint were recorded for the nearest young manduvi in each quadrant. Young manduvis were searched for within a maximum distance of 80 m from the centerpoint. In quadrants where no young manduvis were found, this distance (80 m) was used to fill the gap, as the PCQ requires at least one individual per quadrant. The signed rank test (Wilcoxon 1945) was applied to our data to compare the average densities of the three study areas.

Young manduvis at NHU tended to be of lesser height and closer to the centerpoint than at both CDR and BAU (figure 1). The average manduvi densities were 1.3139 ° 1.2489 (NHU), 0.0009 ° 0.0003 (CDR), and 0.0026 ° 0.0016 (BAU) individuals m^{-2}. The densities of young manduvis at BAU and CDR did not differ significantly ($P = 0.959$, $Z = -0.052$, d.f. = 39), but the young manduvi density at NHU differed significantly from the other two areas ($P < 0.001$, $Z = -3.730$ and -3.544, d.f. = 39). The

majority (91.3 %) of the young individuals at NHU had a basal diameter less than 10 cm, whereas in both CDR and BAU, over 60 % of individuals exhibited basal diameters over 10 cm. Within NHU, approximately 78 % of young manduvis recorded were less than 3 m in height, whereas at CDR and BAU, 66 % and 75 % of the individuals, respectively, were taller than 3 m (figure 2).

The results suggest that outside NHU there is an establishment gap for manduvi recruits (figure 2). Within NHU the height distribution of those individuals recorded suggests a higher survivorship of seedlings than in CDR and BAU, where individuals from one to five m in height are relatively rare. It is likely that within NHU, after five years of protection, seedling establishment has improved due to a lack of cattle trampling, grazing, and burning. Improvement of microhabitat conditions could also be promoting higher seedling survivorship. These results contain two sources of bias: first, the PCQ method does not produce an accurate sample of population structure because it is limited to the measurements of one individual per quadrant (nearest to the center point); secondly, by limiting our search for young manduvis at 80 m from the centerpoint, the estimated densities are higher than actual. However, because the method used in this study was equally applied among the study areas, the results are comparable. A more detailed survey using random plots would be necessary to assess the actual density and population structure of manduvis under different management conditions.

The most common cause for the decline or extinction of American birds is habitat change (Caughley and Gunn 1996). Hyacinth Macaw populations have historically been affected by an illegal pet trade, but habitat loss has also greatly contributed to this species' decline (Thomsen and Brautigam 1991). Cattle have been present in the Pantanal for more than two centuries, and the cumulative long-term effects of grazing and burning could be disrupting the habitat dynamics of the floodplain. Prance and Schaller (1982) reported that little vegetation remains intact in the Pantanal because of the effects of cattle, fire, man or a combination of all three.

Young manduvis are foraged by cattle (Janzen 1972, Pott and Pott 1994) which may cause high seedling mortality (Janzen 1972). In the Pantanal, cattle have a considerable effect on the forest understory vegetation, particularly through selective grazing and trampling (Prance and Schaller 1982). High frequency fire may prevent trees in forested habitats from surviving to a size capable of providing usable cavities for birds (*e.g.*, Newton 1997). Pott and Pott (1994) suggest that fire may promote cavity formation in adult manduvis. However, the results of Guedes (1993) indicate that fire causes a high rate of nesting tree loss. Scarcity of nest cavities is known to limit the breeding density of parrot species in some areas (*e.g.*, Beissinger and Bucher 1992, Munn 1992). For example, competition for scarce nest sites has been reported as an important factor in the late stages of the decline of the Costa Rican Parrot (*Amazona vittata*),

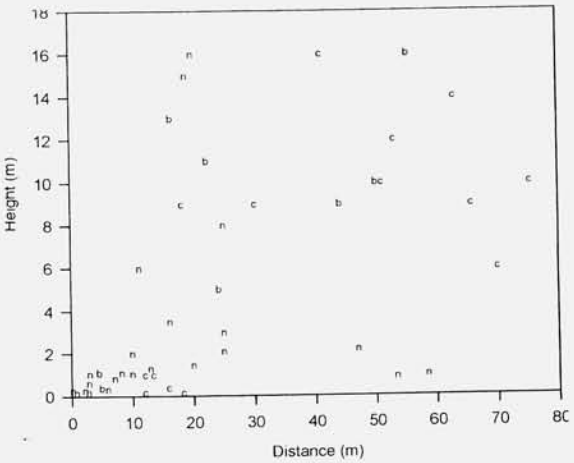

Figure 1. Relationship between height and distance from the centerpoint for young manduvis at NHU (n), CDR (c), and BAU (b).

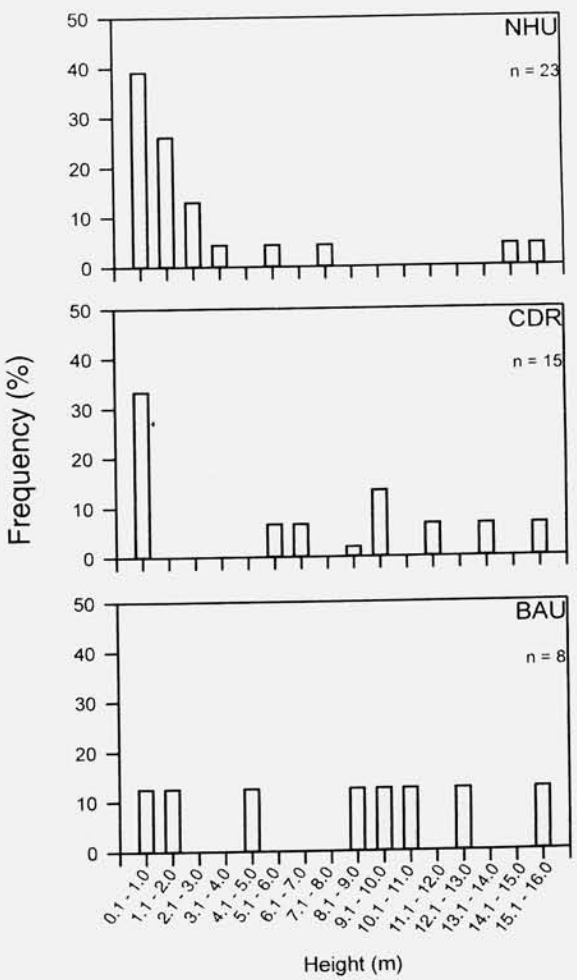

Figure 2. Relative frequencies of young manduvis sampled at NHU, CDR, and BAU by height class.

which in 1975 numbered only 13 individuals (Wiley 1985, Snyder *et al.* 1987).

Species that are not primary excavators are more often short of sites for nesting (Newton 1994). The Hyacinth macaw is included in this group of species, as breeding pairs only improve pre-existing suitable cavities (Munn *et al.* 1987, Guedes 1993, 1995, Guedes and Harper 1995). Because the Hyacinth Macaw's nesting sites are located mostly in old manduvis or those already in senescence, disruptions in the population dynamics of this tree, associated with increased loss of nesting trees, could result in a steady decline of this macaw's recruitment throughout the Pantanal. We strongly suggest that conservation efforts for Hyacinth macaw should also focus on manduvi population dynamics, including the effects of grazing, trampling, and burning, as well as seed dispersion.

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