PROTECTED *CERRADO* FRAGMENTS GROW UP AND LOSE EVEN METAPOPULATIONAL BIRDS IN CENTRAL SÃO PAULO, BRAZIL

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ABSTRACT

Moderately dense woodland (*cerradão*) grew in two isolated patches of bushy savanna (*cerrado*) in central São Paulo over 23 years of bird censuses. Various uncommon birds were lost and some forest species were permanently gained. Fall and winter fruits attract long and short-distance migrants. Woodpeckers and some birds that nest in their holes seem to disappear during tree growth. Some birds in weedy areas nearby disappeared when the pastures replaced these areas, however sugar cane reduced the numbers of birds even more up to the point when some areas became pastures once more. Even travel-prone species disappear with vegetation growth in *cerrado* protected fragments, and therefore "metapopulations" may not survive over time, only in space.

Keywords: birds, *cerrado*, extinctions, forest growth, metapopulations, savannas.

RESUMO

Fragmentos protegidos de cerrado crescem e perdem mesmo aves metapopulacionais na região central do Estado de São Paulo, Brasil

Dois fragmentos isolados de cerrados, na região central do Estado de São Paulo, desenvolveram-se a moderadamente densa vegetação (cerradão) em cerca de 23 anos de levantamento de aves, perdendo permanentemente várias aves raras e ganhando espécies de mata. Os frutos do outono e inverno atraem os migrantes de longa e curta-distância. Os picapaus e algumas aves que nidificam em buracos parecem desaparecer durante o crescimento das árvores. Algumas aves de áreas com ervas desapareceram com os pastos, mas a cana-de-açucar reduziu ainda mais o número de aves até os pastos crescerem. Mesmo as espécies que se movimentam muito desaparecem com o crescimento da vegetação nos fragmentos protegidos de cerrado, de forma que "as metapopulações" podem não sobreviver com o tempo, somente com o espaço.

Palavras-chave: aves, cerrado, crescimento florestal, extinção, metapopulações, savanas.

INTRODUCTION

As agriculture develops, *cerrado* (savanna) areas in central Brazil are disappearing. Only some fragments are protected, usually small ones without corridors, although some large parks have been set aside. In 1982, I started studying birds in open or "campo *cerrado*" zones near Itirapina in central São Paulo State (Willis, 2004). Since then, I have also observed birds from some semi-open "*cerrado* sensu strictu" areas, notably two patches east of Itirapina, one being an area protected by a university (UNESP) and the other by cane planters.

These two patches are fragments of a large *cerrado* zone that was mostly destroyed in 1981 for pastures and sugar cane (R. Monteiro, pers. comm.) on both sides of the main highway northwest between the cities of Rio Claro and São Carlos.

Although the wooded savanna was low or irregular at the time, these areas have grown so much that they have become *cerradão* woodland.

Common secondary forest birds are lost in isolated zones as tall forests grow back (Willis, 1974), and here it was found that similar losses of uncommon *cerrado* birds occur in isolated *cerrados* with regrowth. Some woodland species have moved in, but most that wander in have been unable to maintain metapopulations. Nearby open zones also lost other birds when they were widely planted with relatively birdless sugar cane.

STUDY AREAS AND METHODS

The ´UNESP *cerrado*` is a 38.7-ha fragment at 865 m and 22° 14' S and 47° 41' W, which has been surrounded by pastures and sugar cane since 1981. This area is on top of a flat and sandy plateau or tableland, which drops off to formerly forested lowlands just east and south. Wooded zones and creeks occur irregularly along the drop-off, and some have been protected. Scattered woodlots are protected in the lowlands, for instance those of Fazenda São José near Rio Claro (Willis & Oniki, 2002). Scattered *cerrado* zones occur off west, but there are mostly pastures and cane, orange or tree plantations.

Two km west, across cane fields and beyond km 200 on the Washington Luiz main highway (at 850 m, and 22° 15' S and 47° 43' W, on the border of the townships of Corumbataí to the east and Itirapina to the west), the similar-sized but scrubbier ´km 200` *cerrado* fragment was observed occasionally. Surrounded by roadsides and cane, it is also near narrow wooded drop-offs from the edge of the ´chapada`. Some areas were burnt in 1982 and some trees were cut. As in the case of the *cerrado* at UNESP, many areas have grown into shady *cerradão* since 1981.

Transect censuses listed numbers of birds heard or seen in 74 visits (260.7 h) at UNESP and 14 visits (35.7 h) at the km 200 areas, 8 April, 1982 to 1 February, 2005. Birds of surrounding open (or pond) areas were noted separately, as were birds flying over. Here, birds are noted "per 100 h." Furthermore, some UNESP visits were with students.

Use of these areas by Picazuro Pigeons (*Columba picazuro*) invading the state was registered by Willis & Oniki (1987). Thrushes after army ant swarms were noted by Willis (1984) and the presence of one species of *Hylophilus* in Willis (1991). Willis & Oniki (2003) briefly noted birds up to 1998 with dates and times of censuses.

RESULTS

Open-area birds –Various scrubby or grazed pastures around UNESP were planted with sugar cane in 1984, and then they became open pastures in some areas after 2000. Cane plantations and more efficient cattle use led to lower numbers of some birds from 1984 onwards (Table 1). Birds that disappeared or almost disappeared included three hawks, one *Anumbius* (which also disappeared in most other areas regionally, perhaps due to recent warm and dry years; Willis, 2004), plus two *Synallaxis* and a *Thamnophilus* of weedy-bushy zones. The loss of *Gnorimopsar* could be due to catching cage birds, as in the region in general (Willis, 2004). *Geothlypis, Anthus, Stelgidopteryx* and *Xolmis velata* continued to be less common even after several cane areas returned to pastures. Some others were never very common (*Nothura, Falco* spp., *Tyto, Bucco, Xolmis cinerea*, *Notiochelidon, Progne, Molothrus, Sporophila* spp.). Others became more common again when pastures replaced several cane areas (*Syrigma, Caracara, Vanellus, Athene, Guira, Zenaida, Crotophaga, Tachycineta, Mimus*).

Some regular open-zone birds changed little in abundance despite the cane plantations: *Crypturellus, Milvago, Herpetotheres, Cariama, Colaptes, Furnarius. Bubulcus* (and woodlot-nesting and roosting *Columba picazuro*) have moved into the region in recent years. *Sicalis citrina* and *Pseudoleistes* have appeared recently in small numbers. *Sicalis luteiventris* flocks have been reported by local pasture owners (it is increasing regionally where ungrazed *Brachiaria* is allowed to seed; Antunes & Willis, 2003). A recent rarity of *Volatinia* may be due to the loss of woodlot grass, rather than to pasture or cane effects; it is still common in the locally grassy km 200 site.

Water birds were little studied as they are mostly at rather distant ponds or creeks downhill; water areas and creeks are often lacking in protected areas in the state. A small gully that crosses the km 200 area has some water after rain and attracts seed-eating birds.

TABLE 1
Pasture, Pond, and Passing Birds.

	A	B	C	D	E
Nothura maculosa	8	3	3	-	3
Crypturellus parvirostris	21	28	29	16	7
Ardea alba F	1	-	-	-	-
Bubulcus ibis	-	41	128	-	-
Syrigma sibilatrix	6	6	24	-	-
Vanellus chilensis	67	46	79	95	7
Jacana jacana W	4	-	-	-	-
Aramides cajanea W	-	-	2	-	-
Cariama cristata	34	43	61	-	-
Coragyps atratus F	111	97	53	127	150
Cathartes aura F	-	3	7	-	3
Elanus leucurus	2	3	-	-	-
Harpagus diodon F	-	1	-	-	-
Leptodon cayanensis F	2	-	-	-	-
Ictinia plumbea F	-	3	-	-	-
Accipiter striatus F	1	3	-	-	-
Buteogallus meridionalis	3	-	-	-	-
Buteo brachyurus	1	1	-	-	-
Buteo albicaudatus	1	-	-	-	-
Herpetotheres cachinnans	7	4	2	-	-
Milvago chimachima	4	16	7	-	3
Caracara plancus	35	7	16	-	24
Falco sparverius	8	4	1	-	3
Falco femoralis	4	4	3	-	-
Tyto alba	-	4	1	-	-
Athene cunicularia	18	6	17	-	7
Crotophaga ani	36	-	8	-	-
Guira guira	103	-	11	-	17
Zenaida auriculata	131	69	97	-	31
Brotogeris chiriri F	-	-	6	-	24
Aratinga leucophthalmus F	112	92	69	32	175
Pionus maximiliani F	-	3	4	-	-
Streptoprocne zonaris F	17	20	-	-	-
Chaetura meridionalis F	3	-	-	-	-
Ceryle torquata W	1	-	1	-	-
Bucco chacuru	3	-	6	-	-
Colaptes campestris	41	39	42	-	7
Melanerpes candidus F	42	28	9	-	14
Anumbius annumbi	3	-	-	-	-
Furnarius rufus	24	26	34	-	7
Synallaxis spixi	14	3	1	-	7
Synallaxis albescens	16	1	-	63	3
Certhiaxis cinnamomea W	2	-	-	-	-
Thamnophilus ruficapillus	11	3	-	-	-
Xolmis cinerea	3	-	-	-	-
Xolmis velata	20	1	5	-	-
Machetornis rixosus	-	-	3	-	3
Myiophobus fasciatus	-	-	2	-	3

TABLE 1
Continued...

	A	B	C	D	E
Tachycineta leucorrhoa F	50	6	72	-	3
Stelgidopteryx ruficollis F	32	7	10	126	7
Notiochelidon cyanoleuca F	8	3	2	-	34
Progne tapera F	6	5	-	-	-
Mimus saturninus	30	12	21	-	20
Donacobius atricapilla W	12	2	-	-	-
Anthus lutescens	12	7	2	-	-
Geothlypis aequinoctialis	15	7	6	16	14
Gnorimopsar chopi	19	2	-	-	-
Agelaius ruficapillus	-	-	1	-	-
Pseudoleistes guirahuro W	1	3	8	-	-
Molothrus bonariensis	3	-	1	-	-
Volatinia jacarina	57	99	2	63	92
Sporophila caerulescens	12	-	7	-	61
Sporophila lineola	-	-	7	-	-
Sicalis citrina	1	-	4	-	-
Ammodramus humeralis	108	32	26	-	3

A, D – 1982-83; B – 1984-97; C, E – 2000-05; F – Flying over; and
W – Water birds.

Birds flying over included *Ardea, Cathartes, Coragyps* (lower numbers recently, perhaps due to difficult viewing with a taller canopy; at times perches in trees, but not seen eating), *Melanerpes, Aratinga*, and in recent years *Pionus* and *Brotogeris*. Occasional hawks flew over (*Leptodon, Accipiter, Buteo brachyurus, Ictinia* and *Harpagus*, the latter two summering migrants in November). Swifts included a few *Chaetura* and some flocks of *Streptoprocne* (last 15 on 7 May, 1986; the species has become rare as tourists descend waterfalls where it nests, see Willis, 2004).

Open-area birds at km 200 showed similar changes between 1982-83 and 2001-05 (Table 1, D-E), with a few *Synallaxis spixi* and *S. albescens* (and *Elaenia chiriquensis* and *Geothlypis*) still in weedy/bushy sites within the area. Some 37 of 65 species recorded near the UNESP zone were not recorded.

Woodland birds – The 115 woodland and *cerrado* species (10 only at km 200, there were 71 in total) can be found in Table 2 (D-E for km 200). Forty one woodland and edge species were seldom recorded; as most transects were done during the day: two night birds *(Otus, Nyctibius*) and five hummingbirds *(Amazilia, Thalurania, Colibri, Eupetomena, Calliphlox)* and *Coereba* as the flowers were not studied much.

Some infrequent trunk species (*Dryocopus, Picumnus, Lepidocolaptes, Xenops*) and understory birds (*Baryphthengus, Synallaxis ruficapillus, Automolus, Mackenziaena, Platyrinchus, Basileuterus leucoblepharus, Tachyphonus, Trichothraupis, Ramphocelus*) as well as border species (*Hypoedaleus, Taraba, Pachyramphus, Serpophaga, Todirostrum, Tyrannus savana, Megarynchus, Empidonomus, Myiodynastes, Hemitriccus nidipendulus, Manacus, Troglodytes, Conirostrum, Nemosia, Thlypopsis, Thraupis palmarum*) may be increasing or moving in occasionally as the *cerrado* grows, but most do not seem to have established metapopulations yet. Recent entry of *Hypoedaleus* and *Baryphthengus* is interesting, as they have disappeared in much larger woodlots regionally (Willis, 1979; Willis & Oniki; 2002); but they may not survive. *Empidonomus, T. savana*, and some others nest in the km 200 more open *cerrado*, and four hummingbirds, which were seldom recorded, visited flowers there.

Eleven migrants were also recorded infrequently. One (understory *Catharus* from North America) was recorded on 9 Dec, 2001 and 3 March,

TABLE 2
Woodlot Birds.

	A	B	C	D	E
Buteo magnirostris	29	15	21	79	17
Penelope superciliaris	17	27	23	-	-
Columba picazuro	65	146	225	-	85
Columba cayennensis	106	200	59	-	-
Columbina talpacoti	132	50	43	-	71
Columbina squammata	19	5	-	-	-
Leptotila verreauxi	61	99	57	48	20
Piaya cayana	5	26	11	63	10
Tapera naevia	4	1	-	16	-
Otus choliba	-	-	4	-	-
Nyctibius griseus	-	-	1	-	-
Nyctidromus albicollis	1	7	8	-	-
Hydropsalis torquata	13	8	10	-	-
Phaethornis pretrei	12	15	5	32	7
Hylocharis chrysura	10	3	-	-	3
Thalurania glaucopis	1	-	-	-	3
Amazilia lactea	1	1	-	-	7
Chlorostilbon aureoventris	9	3	7	16	10
Colibri serrirostris	4	-	1	-	-
Eupetomena macroura	1	-	5	16	-
Leucochloris albicollis	2	3	-	-	-
Melanotrochilus fuscus	-	-	-	16	7
Aphantochroa cirrochloris	-	-	-	-	7
Anthracothorax nigricollis	-	-	-	16	-
Heliomaster squamosus	-	-	-	-	3
Calliphlox amethystina	-	-	1	-	-
Baryphthengus ruficapillus	-	-	2	-	-
Ramphastos toco	2	-	10	-	-
Picumnus albosquamatus	2	-	8	-	3
Colaptes melanochloros	19	3	6	16	-
Veniliornis passerinus	18	3	5	-	13
Dryocopus lineatus	1	-	2	-	3
Lepidocolaptes angustirostris	-	-	-	-	3
Xenops rutilans	-	-	1	-	-
Synallaxis frontalis	74	35	63	79	105
Synallaxis ruficapillus	-	-	1	-	-
Automolus leucophthalmus	-	3	-	-	3
Hypoedaleus guttatus	-	-	2	-	-
Mackenziaena severa	1	-	-	-	-
Taraba major	-	-	1	-	-
Thamnophilus pelzelni	34	115	49	-	-
Thamnophilus caerulescens	53	28	60	-	-
Thamnophilus doliatus	6	-	17	16	20
Formicivora rufa	-	-	-	79	-
Conopophaga lineata	10	19	15	-	37
Tityra cayana	-	1	-	-	-
Pachyramphus polychopterus	-	-	-	16	-
Phibalura flavirostris	3	-	-	-	-

TABLE 2
Continued...

	A	B	C	D	E
Manacus manacus	-	-	-	-	3
Chiroxiphia caudata	3	11	63	-	95
Antilophia galeata	4	-	32	-	20
Neopelma pallescens	1	-	-	-	-
Pitangus sulphuratus	51	32	29	16	20
Myiozetetes similis	6	27	12	-	-
Megarynchus pitangua	2	1	-	-	-
Myiodynastes maculatus	1	-	4	-	-
Empidonomus varius	-	-	2	95	37
Myiarchus tyrannulus	48	72	28	16	7
Myiarchus ferox	1	3	16	-	14
Myiarchus swainsoni	39	8	-	-	-
Casiornis rufus	39	30	-	16	-
Cnemotriccus fuscatus	34	27	49	16	17
Lathrotriccus euleri	3	10	15	-	-
Contopus cinereus	-	-	1	-	-
Platyrinchus mystaceus	-	3	-	-	-
Tolmomyias sulphurescens	-	-	12	16	3
Elaenia flavogaster	12	4	23	16	34
Elaenia obscura	105	101	154	16	7
Elaenia parvirostris	2	-	2	-	-
Elaenia cristata	9	-	-	-	-
Elaenia mesoleuca	7	16	-	-	-
Euscarthmus meloryphus	22	4	-	-	-
Hemitriccus nidipendulus	3	-	1	63	7
Hemitriccus margaritaceiventer	25	20	9	32	7
Phaeomyias murina	161	78	24	175	-
Camptostoma obsoletum	40	26	23	63	10
Tyrannus melancholicus	9	14	12	95	81
Tyrannus savana	3	1	6	190	10
Serpophaga subcristata	2	-	1	-	-
Todirostrum cinereum	3	1	5	-	10
Troglodytes aedon	3	-	1	48	14
Cyanocorax cristatellus	67	47	60	-	14
Cyanocorax chrysops	14	-	-	-	-
Turdus leucomelas	77	234	172	16	116
Turdus amaurochalinus	205	108	29	32	24
Turdus nigriceps	1	-	-	-	-
Turdus albicollis	1	1	-	-	7
Platycichla flavipes	-	-	1	-	-
Catharus fuscescens	-	-	2	-	-
Vireo olivaceus	45	50	87	16	65
Cyclarhis gujanensis	123	99	78	95	58
Hylophilus amaurocephalus	63	19	43	63	24
Parula pitiayumi	33	11	9	-	-
Basileuterus hypoleucus	91	182	138	127	92
Basileuterus flaveolus	90	99	94	48	68

TABLE 2
Continued...

	A	B	C	D	E
Basileuterus leucoblepharus	3	-	-	-	-
Coereba flaveola	-	-	2	-	14
Thlypopsis sordida	1	-	-	-	7
Dacnis cayana	9	12	33	-	10
Conirostrum speciosum	-	-	2	-	10
Nemosia pileata	-	-	-	-	3
Euphonia chlorotica	1	12	1	-	10
Tangara cayana	71	78	57	32	14
Thraupis sayaca	56	50	31	63	31
Thraupis palmarum	-	-	1	-	-
Tachyphonus coronatus	1	3	1	-	20
Ramphocelus carbo	5	1	2	-	14
Trichothraupis melanops	1	3	-	-	-
Tersina viridis	1	4	1	-	-
Schistochlamys ruficapillus	85	6	-	63	-
Saltator similis	1	4	8	-	-
Coryphospingus cucullatus	100	43	21	79	17
Arremon flavirostris	-	-	-	-	14
Zonotrichia capensis	159	88	36	429	92
VISITS	26	24	24	4	10
HOURS	98.3	74	88.4	6.3	29.4

2002; it spends the winters in central and southern Brazil in the *cerradão* and woodland zones, and is probably menaced by recent woodland removal (Remsen, 2001). Occasional winter birds from the south (*Leucochloris, Phibalura, Contopus, Turdus albicollis, Platycichla*) use *cerradão* zones with flowers or fruit, while passage migrants from the south (*Elaenia parvirostris, E. mesoleuca, Turdus nigriceps, Tityra*) also use fruit. The *cerradão* seems to have more fruit than *cerrado* here, and therefore most of these migrants probably still occur.

The local migrant *Elaenia obscura* is abundant in fall and winter, using local *Miconia, Pera glabrata* and other fruits that are even more common now; it nests only in gallery woods near creeks in the region. Two semi-resident thrushes, *(Turdus leucomelas and T. amaurochalinus)* also enter commonly in the fall and winter at the same time as small trees produce fruit in the *cerradão*.

The former species is now more common, as elsewhere in the interior of the state, after having recent dry and warm years (perhaps replacing *T. amaurochalinus* somewhat). Both species occasionally nest in the *cerradão* fragments here, and followed *Labidus* ants in the UNESP area years ago (Willis, 1984). Recently only the km 200 area has had swarms and therefore army ants may have become extinct in the UNESP fragment (*Eciton burchelli* extinct in both areas).

Tersina, Myiozetetes and *Pitangus* ("local migrants") also wander in for fruit in fall and winter, without nesting. *Myiozetetes* has become more common and *Pitangus* less so as the *cerradão* has grown over the years. *Ramphastos toco* also visits for fruit, though it needs large trees to nest, and is a species that is increasing in the region (Willis & Oniki, 2002; Willis, 2003). Increases in *Dacnis* and *Saltator* wanderers in recent years could also be due to fruit or growth of trees. Some fruit trees could have been introduced by fruit-eating birds that wander in (M. Pinheiro, pers. comm.).

Some other species that are now more common are understory fruit eaters (*Chiroxiphia, Antilophia*) and they occur locally mostly in gallery or escarpment woods. *Myiarchus ferox* also seems to wander in from nearby gallery woods more, perhaps as it uses fruit and prefers woodlands and not hot *cerrados*. *M. tyrannulus* has decreased, even though it uses fruit, perhaps as it uses more open *cerrados* and edges or has lost cavities for

nests. The loss of summer *M. swainsoni* lately is unexplained, or due to the loss of woodpecker holes (below) to nest, as it uses both the woodland canopy and edge, even woods too tall for *ferox*.

Other species of the sixteen that have increased in number do not always use fruit, but prefer shady woodlands and avoid *cerrados*: *Piaya, Lathrotriccus, Tolmomyias*, summer *Vireo, Basileuterus hypoleucus. Columba picazuro* has become more common in the state in recent years (Willis & Oniki, 1987), perhaps causing some decrease in *C. cayennensis* here due to use of perches to sing or nest (the latter eats fruits, the former seeds more in open zones; they perhaps compete somewhat for food). *Tolmomyias* males try to establish midlevel or understory metapopulations even on the Rio Claro campus or in a suburb in Barão Geraldo (Campinas), but here and there do not seem to succeed; stable populations and nests are in somewhat taller woods, even a small woodlot at Sítio Novo Horizonte near Rio Claro (pers. obs.). It has not been in the UNESP *cerrado* except for July, 2000 to January, 2003, and km 200 in June, 1982 and February, 2005.

Some 16 species have maintained populations in woodland growth: *Penelope* and *Leptotila* eating fruit (and border *Elaenia flavogaster, Tyrannus melancholicus, Tangara* and *Thraupis sayaca* fruit and insects); *Nyctidromus* and *Hydropsalis* night insects at the edges (though the latter needs semi open edges to nest and spend the day); *Camptostoma* and *Thamnophilus doliatus* insects at the edges; understory insectivores *Synallaxis frontalis, Cnemotriccus*, *Thamnophilus pelzelni, T. caerulescens, Conopophaga* and *Basileuterus flaveolus* (though the first three need semi open edges and not tall woods); and *Chlorostilbon* at flowers.

Growth of woodland, low populations and entry of competitors are likely causes of lower numbers for 25 species. Four insect-fruit eaters (*Myiarchus* spp., *Pitangus, Turdus amaurochalinus*) are discussed above, as fruit-eating *Columba cayennensis*. One edge hawk (*Buteo*) is only slightly less common. Two jays (*Cyanocorax*) have decreased, the wood-interior one disappearing, probably with the loss of the initial population (it survives in other *cerradões*). Five that eat herb seeds or insects in semi-open *cerrado* or on the edges *(Columbina* spp*, Schistochlamys, Coryphospingus, Zonotrichia)* have become rarer and *C. squammata* and *Schistochlamys* are extinct in the area. *Tapera*, a locally extirpated edge species that mostly parasitizes nests of *Synallaxis*, lost two open-area hosts but not wood-edge *S. frontalis*; perhaps the latter hides nests in the *cerradão*. Two edge hummingbirds (*Phaethornis, Hylocharis*) and woodpeckers (*Colaptes melanochloros, Veniliornis*) are perhaps not adapted for very shady *cerradão*. Growing trees perhaps rarely provide dead trunks to excavate nests. There was a complete loss of insectivorous *Casiornis*, which nests in woodpecker holes and uses moderately open *cerradão*, paralleling losses of related *Myiarchus* spp. It has disappeared recently in other *cerradões* near Itirapina (studies in progress). Melletti & Penteriani (2003) found few woodpeckers in regrowing woods and Fort & Otter (2004) found less success of a hole-nesting bird in a regrowing forest in Canada. Small insectivorous flycatchers of *cerrado* are also disappearing here and in other growing *cerradões* near Itirapina: *Euscarthmus, Hemitriccus margaritaceiventer, Phaeomyias* (mostly a summer bird, working low canopies), plus a greenlet *Hylophilus*. *Cyclarhis* and *Parula* of open canopies have decreased, but are still fairly common. An understory bird of *cerrado* or gallery edges, now absent in the whole region, was only seen in November 1983 (*Neopelma*).

Other campo and *cerrado* birds of the region (see Willis, 2004) were not recorded, or only in or near the km 200 more open habitat (*Lepidocolaptes; Formicivora*, now gone there; *Suiriri suiriri* and *Melanopareia torquata* and *Saltator atricollis* were recorded only just west in other patches of more open *cerrado*). The UNESP and km 200 areas were probably too dense for the last three species, even in 1982.

DISCUSSION

Even though *cerrado* and open-area birds can generally fly to distant habitat fragments, they (and nearby "travel-prone" or metapopulational woodland birds) are not always able to establish new populations or keep old ones going. A major problem is that protected fragments tend to grow, or are only rarely pruned or catch fire. Thus, the "metapopulation" theory which was very prominent in the literature some years ago is mostly applicable to open habitats in arctic or sub arctic

regions, where vegetation does not grow much even if preserved. The theory applies to patchiness of habitat in space, not over time.

In this case, some species increased and others remained in growing bushy savannas, now medium-tall *cerradão*. Unfortunately, many woodland species that came in from outside tended to be rare or not establish local reproduction, while several bushy-*cerrado* birds declined to local extinction. Some of these latter species are common, but a few are rather rare and subject to regional extinction (*Elaenia cristata, Neopelma, Casiornis, Euscarthmus*).

It may be that, in the Corumbataí/Itirapina region, some *cerrado* and campo zones will not grow because of sandy soil. However, even open sandy savannas protected from fire near Itirapina are growing into dense herbaceous vegetation or bushy zones, rather than staying open (Willis, 2004).

One cannot assume that birds able to cross agricultural or pasture zones between habitat fragments will be able to find habitat and mates and reproduce enough to reestablish populations. The "metapopulation" idea was quite optimistic about this possibility, but was mainly espoused by workers in temperate/arctic zones where vegetation is naturally low and grows slowly (and birds are mostly migrants which fly easily from one patch to another). Northern scientists often thought linking patches with corridors would not be necessary and that birds would quickly repopulate distant areas after loss or habitat changes.

A lack of connecting low or medium-tall corridors may be a problem in the future, as well as a lack of fire and other management methods. Larger areas of *cerrado*, off the north and west, may preserve the species lost here, if current enthusiasm about using the savannas for cattle, cane, orange, and soybean production eventually wanes. Cane, as shown here, has few birds and causes losses of even some pasture birds.

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