

Unexpected cleaners: Black Vultures (*Coragyps atratus*) remove debris, ticks, and peck at sores of capybaras (*Hydrochoerus hydrochaeris*), with an overview of tick-removing birds in Brazil

Ivan Szazima

Departamento de Zoologia e Museu de História Natural, Caixa Postal 6109, Universidade Estadual de Campinas, CEP 13083-970, Brasil. E-mail: isazima@unicamp.br

Recebido em 16 de janeiro de 2007; aceito em 18 de maio de 2007.

RESUMO: Limpadores inesperados: urubus-de-cabeça-preta (*Coragyps atratus*) removem detritos, carrapatos, e bicam ferimentos de capivaras (*Hydrochoerus hydrochaeris*), com um resumo sobre aves carrapateiras no Brasil. Aves limpadoras removem ectoparasitos e também se alimentam em ferimentos de grandes mamíferos herbívoros, uma associação bem conhecida entre búfagas ou pica-bois (gênero *Buphagus*, Buphagidae) e ungulados na África. Apresento aqui urubus-de-cabeça-preta limpando capivaras (*Hydrochoerus hydrochaeris*) no Sudeste brasileiro e postulo uma seqüência de passos que podem ter dado origem a limpeza por aves onívoras e necrófagas. A etapa inicial seria a familiaridade destas aves com carcaças, das quais retiram pequenas porções de tecido, resíduos orgânicos e parasitos – seguida por etapas intermediárias de ajustes comportamentais entre os limpadores e os “clientes” – culminando em simbiose de limpeza com mamíferos herbívoros de médio a grande porte. São ainda descritos quatro exemplos de aves (*Molothrus oryzivorus*, *Milvago chimachima*, *Machetornis rixosa* e *Crotophaga ani*) que removem carrapatos e/ou outros ectoparasitos de mamíferos herbívoros, além de ser apresentada uma lista de 12 espécies registradas removendo parasitos de mamíferos herbívoros no Brasil. Indico a semelhança entre os hábitos de urubus Cathartidae e espécies de Caracariní (Falconidae), havendo registro de remoção de carrapatos em ambos os grupos. Também, sugiro que espécies de *Phalcoboenus* (Falconidae) e *Cyanocorax* (Corvidae) poderiam ser limpadores potenciais. As aves que removem parasitos são aqui agrupadas em duas categorias amplas, que acomodariam registros adicionais deste tipo: 1) espécies onívoras e necrófagas, que vivem em áreas abertas, forrageiam amplamente e se associam a capivaras e/ou ungulados silvestres e domésticos; e 2) espécies predominantemente insetívoras, que vivem em áreas abertas, forrageiam amplamente e que também se associam a capivaras e/ou ungulados silvestres e domésticos. As exceções a estes dois grupos seriam *Ibycter americanus* e *Psophia leucoptera*, respectivamente, por ambas serem habitantes de áreas florestadas.

PALAVRAS-CHAVE: Simbiose de limpeza, aves-carrapateiras, associações entre aves e mamíferos.

ABSTRACT: Cleaner birds remove ectoparasites and also feed on wounded tissue from herbivorous mammals, an association well known between oxpeckers (genus *Buphagus*) and ungulates in Africa. I report here on Black Vultures (*Coragyps atratus*) cleaning capybaras (*Hydrochoerus hydrochaeris*) in southeastern Brazil, and postulate a sequence of steps that might have given origin to cleaning in omnivorous scavenging birds. The first step would be the familiarity these scavengers have with carcasses, from which they remove small tissues pieces and organic debris, and parasites, followed by a few intermediate steps with behavioural adjustments between the cleaners and their clients, and culminating in cleaning symbiosis with medium to large herbivorous mammals. Moreover, four instances of tick-removal by birds (*Molothrus oryzivorus*, *Milvago chimachima*, *Machetornis rixosa* and *Crotophaga ani*) from medium to large herbivorous mammals are described, and a list of 12 species of tick-removing birds recorded for Brazil is presented. The similarity between the habits of cathartid vultures and Caracariní falcons is pointed out, tick-removing being recorded for both groups. I suggest that species of *Phalcoboenus* (Falconidae) and *Cyanocorax* (Corvidae) might be potential cleaners. Parasite-removing birds are here grouped in two broad categories that would accommodate additional records of this type: 1) omnivorous scavengers and widely foraging birds that dwell in the open and associate with capybaras, wild ungulates, and/or livestock; and 2) largely insectivorous, widely foraging birds that dwell in the open and which also associate with capybaras, wild ungulates, and/or livestock. The exceptions to these two groups would be *Ibycter americanus* e *Psophia leucoptera*, respectively, as both species are forest-dwellers.

KEY-WORDS: Cleaning symbiosis, tick-removing birds, bird-mammal associations.

In cleaning symbiosis the cleaners remove parasites and feed on wounded tissue and body fluids from so called clients, an association best documented among reef fishes (reviews in Losey 1987, Côté 2000, Grutter 2005). There are several examples of cleaners among birds as well, the most acknowledged association being that between Oxpeckers (genus *Buphagus*, Buphagidae) and ungulate mammals in Africa (e.g., Fry *et al.* 2000, Weeks 2000). Besides oxpeckers, the Ethiopian region harbours several species of tick-removing and sore-pecking passerine birds, in the Corvidae and Sturnidae (Fry *et al.* 2000). In the Palearctic, Nearctic, and Oriental regions there are several species of Corvidae, Sturnidae, Icteridae, and even

Phasianidae, which feed on ectoparasites of ungulates (e.g., Baber and Morris 1980, Massei and Genow 1995, Fitzpatrick and Woolfenden 1996, and references therein).

In the Neotropics, this association type is less studied than in other areas, although in Brazil an often cited cleaner is the Yellow-headed Caracara (*Milvago chimachima*, Falconidae), which removes ticks from domestic and wild herbivorous mammals (e.g., von Ihering 1946, Sick 1997). A recent paper on feeding associations between birds and the large amphibious rodent capybara (*Hydrochoerus hydrochaeris*) records new parasite-pickers and gives an account of the literature on bird cleaners in the Neotropics (Tomazzoni *et al.* 2005).

I report here on Black Vultures (*Coragyps atratus*, Cathartidae), a widespread scavenger (Figure 1), cleaning capybaras in southeastern Brazil, and comment on the morphological and behavioural traits that might have facilitated and originated this foraging mode. I also report on a few additional bird species recorded cleaning capybaras or livestock. Additionally, I present an overview of tick-removing birds in Brazil, grouping them in two broad ecological categories, and comment on selected traits that might have promoted cleaning. Based on these traits, a few additional South American bird species are suggested as potential cleaners.

METHODS

Capybara groups and livestock were inspected for perched and/or accompanying birds wherever found in the field. However, most records presented here were incidental to other studies or activities, except for a video-taped sequence of Black Vultures cleaning capybaras. Thus, in the account of each bird species I give the place and the period of the observation. The above mentioned video-taped sequence results from an unreleased documentary on the habits of city-dwelling Black Vultures made mostly in 1996 by Paulo



FIGURES 1-6. (1) A group of Black Vultures (*Coragyps atratus*) scavenge on a capybara's carcass – note empty left eye-socket; (2) a Black Vulture search for ticks and debris on the rump of a resting capybara; (3) two Black Vultures from a larger group clean a resting capybara, one bird pecking at the rodent's left hind leg and the other pecking at the back; (4) the cleaned capybara in an inviting posture lying on its back and exposing the belly – note a sore at the right of the vulture; (5) a Giant Cowbird (*Molothrus oryzivorus*) inspects the head of a posing capybara; (6) a Cattle Tyrant (*Machetornis rixosa*) holds in its bill a barely visible tick it caught on the back of a resting capybara. Frames from a video-taped sequence by Paulo Hunold Lara (2-4); photographs by Renato Cintra (1), Carlos Alberto Coutinho (5) and Ivan Sazima (6).

Hunold Lara, to whom I gratefully acknowledge the records. Three taped sequences (total 420 s) were analysed and three frames used here. The sequences were compared with an additional field record and the combined records were used to describe the cleaning behavior of this vulture. One of the records of the Giant Cowbird (*Molothrus oryzivorus*, Icteridae) cleaning capybaras was photographed by Carlos Alberto Coutinho, who is gratefully acknowledged for the record. The recorded sequence (20 images) was analysed and two images are used here. The photographs were compared with an additional field record and the combined records were used to describe the cleaning behavior of this cowbird. All other observations were recorded with use of binoculars or photographed. "Ad libitum" and "behaviour" sampling rules (Martin and Bateson 1986) were used throughout. Only those records that showed that the birds removed or caught ectoparasites such as ticks are presented here, although other ectoparasites (*e.g.*, blood-sucking tabanid and other flies) are mentioned as well. Scientific species names of birds follow the CBRO (2006).

RESULTS

Black Vulture (*Coragyps atratus*). This cathartid was recorded cleaning capybaras at the Parque Ecológico do Tietê in São Paulo (~23°31'S, 46°38'W), and a dammed portion of the Rio Atibaia in Americana (~22°43'S, 47°14'W), both localities in São Paulo state, southeastern Brazil. The videotaped records were made in several periods throughout 1996 (precise dates not stated), mostly in the morning, and the second record was made on 2 November 1999 at about 11:00h and lasted about 5 min. In one taped sequences five vultures from a larger group (10-12), already on the ground and near a group of capybaras, cleaned a juvenile that was lying on its side. The vultures inspected the capybara and pecked at its back and rump, as well as at the belly and legs (Figure 3). The birds removed unidentified, presumably organic debris, ticks, and pecked at sores as well. Upon a more vigorous pecking, presumably a tick removal or a touch on a sore, the capybara jerked or shook the body or an appendage, and on occasions changed its posture (sometimes this action interrupted the vultures' cleaning for a while). Some of the posture changes allowed the bird cleaners to reach several parts of the body including the belly and the internal surface of thighs. A "soliciting", belly-up posture (Figure 4) was displayed only when a capybara was already being cleaned for a while, never being recorded prior to a cleaning session. Resting adults were cleaned as well, usually by one to two vultures at a time (Figure 2). On two occasions during the second field record, a large tick (~1 cm diameter) was clearly seen in the bill of a vulture that was pecking at the flank of a resting adult. Cleaning ceased either when a capybara stood up and moved, or when the vultures retreated, with no obvious causes.

Giant Cowbird (*Molothrus oryzivorus*). This icterid was recorded cleaning capybaras at two sites, the Fazenda Ipiranga at Poconé (~16°30'S, 56°45'W) in Mato Grosso state, southwestern Brazil on 20 May 1997, and on the banks of the Rio São Benedito (coordinates unavailable), a tributary of the Rio Teles Pires, Jacareacanga, Pará state, northwestern Brazil on 26 September 2006. The first record was made at 16:34 h and lasted 8 min, whereas the second began at about 17:00 h and lasted 15-20 min (C. A. Coutinho, pers. comm. 2006). The following short description matches the records at both localities. The Giant Cowbirds were already perched on the moving capybaras or were following them on wing. When a capybara sat or stood in the water, a cowbird inspected its back or head (Figure 5), pecked at a sore (Figure 8), picked off a tick, or deftly caught a fly. Upon a tick removal or a sore pecking, the capybara occasionally shook or twitched the back or the head, which might cause the bird to fly off and return shortly afterwards to the same cleaned individual. The cleaned capybaras displayed no evident soliciting postures except for one individual stretching the neck when a cowbird perched there (Figure 5). The cleaning ceased either when a capybara dived, or the bird flew off with no obvious causes.

Yellow-headed Caracara (*Milvago chimachima*). This falconid was recorded inspecting, picking off ticks from, and pecking at sores of, capybaras and livestock (Figure 7) in the wetlands of the Pantanal at Poconé in southwestern Brazil, and in pasturelands in the states of São Paulo and Minas Gerais, southeastern Brazil. A particularly rich cleaning behavior of this falcon was recorded at São Luís de Paraitinga (~23°16'S, 45°17'W), São Paulo state, southeastern Brazil, on 28 October 2006 at 12:10 h, lasting 17 min. The falcon landed on a grazing Nelore ox and shortly after it inspected the ox's back and removed ticks, rarely pecking at sores. The most evident reaction of the ox was an occasional twitching of the skin on the back or neck (which might be due to flies as well). After a while the ox moved to bare ground where a few oxen were standing. When the ox stopped, the riding bird landed on the ground and from there it inspected the host's belly and inner surface of the thighs. Following a short inspection the falcon jumped upwards flapping its wings, and picked a tick off from the ox's under side. This behaviour was repeated about 15 times in 6 min, the bird pecking at several spots of the ox's under side. In four occasions a large tick (~1 cm diameter) was clearly seen in the falcon's bill. After the series of upwards lunges the falcon flew off, apparently sated. (For records of cleaning interactions between this caracara species and capybaras, see addendum to this paper).

Cattle Tyrant (*Machetornis rixosa*). This tyrannid was recorded only once to catch a tick on a resting capybara, at the Parque Ecológico Prof. Hermógenes Freitas Leitão Filho, Campinas (~22°48'S, 47°11'W), São Paulo state, southeastern

TABLE 1. Tick-removing birds recorded in Brazil. Names of families and species follow the CBRO (2006); genera and species in alphabetical order.

Species	Main feeding habits	Selected references (food habits)
Ardeidae		
<i>Bubulcus ibis</i>	Insectivore, carnivore	Meyerriecks 1960, Sick 1997
Cathartidae		
<i>Coragyps atratus</i>	Scavenger, omnivore	Houston 1994, Sick 1997
Falconidae		
<i>Caracara plancus</i>	Omnivore, scavenger	Sick 1997, Tomazzoni <i>et al.</i> 2005
<i>Daptrius ater</i>	Omnivore, scavenger	White <i>et al.</i> 1994, Sick 1997
<i>Milvago chimachima</i>	Omnivore, scavenger	White <i>et al.</i> 1994, Sick 1997
<i>Milvago chimango</i>	Omnivore, scavenger	White <i>et al.</i> 1994, Sick 1997
Psophiidae		
<i>Psophia leucoptera</i>	Omnivore, scavenger	Peres 1996, Sick 1997
Cuculidae		
<i>Crotophaga ani</i>	Insectivore	Sick 1997, Payne 1997
Furnariidae		
<i>Furnarius rufus</i>	Insectivore, omnivore	Sick 1997, Tomazzoni <i>et al.</i> 2005
Tyrannidae		
<i>Machetornis rixosa</i>	Insectivore	Sick 1997, Tomazzoni <i>et al.</i> 2005
Icteridae		
<i>Molothrus bonariensis</i>	Insectivore	Sick 1997, Jaramillo and Burke 1999
<i>Molothrus oryzivorus</i>	Insectivore, omnivore	Sick 1997, Jaramillo and Burke 1999

Brazil, on 30 January 2000 at about 16:00 h. The bird perched on the capybara's back and from time to time it lunged at an insect that alighted or crawled on the mammal's hair, or flew to the ground to catch an insect flushed by nearby browsing capybaras. Most preys were grasshoppers and leafhoppers. In one occasion the bird inspected the capybara's back, lunged forwards and caught a small tick (Figure 6), which was swallowed following a few mandible movements. As the tick was quickly taken and no pulling was perceived, it likely was either loosely attached or crawling on its host.

Smooth-billed Ani (*Crotophaga ani*). This cuculid was also recorded only once catching a tick on a resting capybara, at the same place described for the precedent species, on 20 February 2000 at about 16:30 h. An ani from a flock of about six individuals was walking on the ground foraging for insects, approached the fore leg of a resting capybara and picked off a medium-sized tick (~0.5 cm diameter). The pulling by the bird was clearly perceptible, but the capybara did not visibly react to the tick-removal.

Twelve bird species are presently reported as usual or occasional parasite-pickers on large herbivorous mammals in Brazil (Table 1). The Wattled Jacana (*Jacana jacana*, Jacanidae), recorded removing ticks from capybaras in Central America (Marcus 1985), probably will add to this list with further field work in Brazil. A photograph of this bird, apparently picking off a tick or another arthropod from the fur of a capybara in the Pantanal wetlands in southwestern Brazil, is shown in Sucksdorff (1985).



FIGURES 7-8. (7) A Yellow-headed Caracara (*Milvago chimachima*) scans the neck of a resting foal; (8) a Giant Cowbird (*Molothrus oryzivorus*) pecks at a sore on a capybara's neck. Photographs by Robson Silva e Silva (7) and Carlos Alberto Coutinho (8).

DISCUSSION

Cleaning by Black Vultures, however unusual as it may seem, can be briefly examined from morphological and behavioural perspectives. From the morphological viewpoint, the Black Vulture is well suited to pick small pieces of food, as its bill is proportionally longer and slenderer than that of any other species in the Cathartidae (Fisher 1944). Among vultures in general this species is classified as a scrapper by Hertel (1994), a category characterized by weak beaks and narrow skulls. Indeed, the Black Vulture is able to remove tiny pieces of flesh from the hide or skeleton of very small carcasses such as those of small mammals and fishes (Sazima 2007), and is able to catch maggots and other live insects as well (Houston 1988, 1994, review in Buckley 1999). The mentioned morphological features render this vulture a picker per excellence, and thus well suited to peck at soft parts and sores to take small pieces of dead or injured tissue, and to remove organic debris and ticks from dead, dying, injured, or sick capybaras and other land mammals with similar habits (*i.e.*, medium to large herbivores that rest in the open at daytime).

From the behavioural viewpoint, the cleaning interaction between Black Vultures and herbivorous medium to large mammals might have followed relatively few and simple steps from one possible origin, and learning processes might have set the stage to favour individuals that would learn or even have innate disposition to put themselves in situations where the learning would be initiated. Black Vultures are familiar with dead, dying, injured, and sick capybaras and larger herbivorous mammals that dwell in the open (*e.g.*, Houston 1994, Sick 1997, pers. obs.). From pecking out soft parts such as eyes and small pieces of viscera that latter soil the body of a dead or dying capybara, to peck at sores, clean organic debris and picks off ticks from a resting individual, a relatively simple and few behavioural adjustments seem needed for the Black Vulture, a versatile bird capable of quick learning (Witoslawski *et al.* 1963) and that takes advantages of the most diverse foraging situations and food types, including maggots (*e.g.*, Haverschmidt 1947, Boti 1990, Houston 1994, Sick 1997, Buckley 1999). Additionally, foraging groups of this species are often composed of familiar groups containing adults and juveniles (Rabenold 1983, 1987, review in Buckley 1999), and thus the latter would have the opportunity to learn new food sources and/or abilities (see Isenhardt and DeSante 1985 for this latter view on tick-picking corvids). The main behavioural steps here postulated from scavenging to cleaning would be: (1) dead or dying mammals such as capybaras would be pecked at sores and perhaps at ticks as well; (2) this situation could be transferred to healthy resting individuals, which might be initially dealt with by the vultures as a potential, latter carcass; (3) while the vultures' behaviour would become a nuisance or be painful, the mammals would retreat or repel the birds; (4) the vultures would learn to seek resting individuals to get food scraps from sores and soiled hair, and to remove ticks as well; (5) while unhurt and not seriously

disturbed, the mammals would be rid of necrotic tissue and parasites, both factors seemingly advantageous for the individuals' health; (6) to facilitate cleaning, some mammal individuals would adopt soliciting postures allowing the birds to reach body parts otherwise unavailable. The capybara's social behaviour (see Lord 1994 and references therein) might facilitate the learning between individuals, which would be the case of social ungulates as well. This seemingly plausible scenario is strengthened by studies on cleaning associations that involve unrelated organisms such as passerine birds, reef fishes, and shrimps as cleaners and mammals, tortoises, marine turtles, and fishes as clients (*e.g.*, MacFarland and Reeder 1974, Losey *et al.* 1994, Massei and Genow 1995, Côté 2000, Grutter 2005, Grossman *et al.* 2006, and references therein). These cleaning associations, however, might have had diverse starting points but resulted in a similar symbiotic relationships, with behavioural adjustments from both involved parties. The scenario here postulated for the origin of cleaning habits of the Black Vulture may well be applied to the next group treated herein, the also scavenging and cleaning caracara falcons (see addendum to this paper).

The Black Vulture and the tick-removing neotropical falconids share omnivorous and scavenging feeding habits, dwell in open areas, and most of them favour the vicinity of capybaras, tapirs, and/or livestock (*e.g.*, White *et al.* 1994, Sick 1997, Galetti and Guimarães Jr. 2004, Tomazzoni *et al.* 2005, present paper). The caracara falcons can forage on very small prey, such as beetles, maggots, and termites (White *et al.* 1994, Sick 1997, pers. obs.). Foraging gatherings of Southern Caracaras (*Caracara plancus*) often are composed of adults and juveniles (White *et al.* 1994, pers. obs.), with the advantages for learning already pointed out for the Black Vulture. Besides ecological and behavioural features, the cleaning falcons may additionally be viewed from a systematic perspective. These falcons include the Black Caracara (*Daptrius ater*), the Southern Caracara, the Yellow-headed Caracara, and the Chimango Caracara (*Milvago chimachima*), which are grouped in the tribe Caracarini (Griffiths 1999, Griffiths *et al.* 2004). Indeed, all Brazilian Caracarini but the Red-throated Caracara (*Ibycter americanus*) [which, contrary to the preceding species, is mostly a forest-dweller (White *et al.* 1994, Sick 1997)] are reported to pick off ectoparasites, mostly ticks, from capybaras and wild or domestic ungulates (White *et al.* 1994, Peres 1996, Sick 1997, Tomazzoni *et al.* 2005, addendum to this paper). The caracara falcons have a relatively weak and unhooked bill ("chicken-like") as compared with other falconids (*cf.* White *et al.* 1994), a morphological feature that renders the caracaras suited for regular or occasional cleaning of native large herbivores and livestock. The latter ungulates likely rendered possible the expansion of these falcons' cleaning roles, which, before the introduction of livestock in the Neotropics, would be restricted to large native herbivores such as capybaras, tapirs, and deers.

Given the open area habitat and the apparently close relationships the preceding falcon species share with the South

American caracaras of the genus *Phalcoboenus* (White *et al.* 1994, Griffiths 1999, Griffiths *et al.* 2004) it would not come as a surprise if an ectoparasite-picker and pecker at sores of large, diurnal herbivorous mammals would be found among these falcons as well. The most likely candidates are the omnivorous and carrion-feeding *Phalcoboenus carunculatus*, *P. megalopterus*, and *P. albogularis* (White *et al.* 1994). The first species feeds on prey as small as maggots and forage in the vicinity of cattle, two additional factors that might promote the origin of cleaning behaviour. The Striated Caracara (*P. australis*), even if seemingly the most specialised of the genus as it forages mostly on sea birds dead or alive, eggs, insects and marine invertebrates (Strange 1996) reportedly attacks weak or stranded sheep (White *et al.* 1994, Strange 1996), a behaviour that is here postulated as one condition that might lead scavenger birds to peck at sores on, and pick ectoparasite from, live grazing mammals. Although species of the genus *Phalcoboenus* remain unrecorded for Brazil (CBRO 2006), I think that the above remarks fit in the present overview as these falcons are part of South American bird fauna and the hypothesis is amenable to testing with field observations focused on the subject.

Except for the White-winged Trumpeter (*Psophia leucoptera*), which is exclusive to forested areas (Peres 1996, Sick 1997), the other tick-pickers dealt with here are an assorted assemblage which has in common insectivorous habits, dwell in open habitats and favour the vicinity of capybaras and/or livestock (Martínez-Vilalta and Motis 1992, Payne 1997, Sick 1997, Tomazzoni *et al.* 2005). With the exception of the Cattle Egret and the Smooth-billed Ani, the remainder open habitat ectoparasite-pickers treated here are Passeriformes. Save for the Giant Cowbird (see Sick 1997), the remainder insectivorous species may be regarded as very occasional cleaners. For instance, the Cattle Egret seems not to fit well in the cleaning category, since most of the ticks found in its diet are blood-gorged ripe females found on the ground and not on the cattle (Meyerriecks 1960, Gonzales 1995, Sick, 1997, Bella 2003). Additionally, there is no a reliable report of the Cattle Tyrant as a tick-picker and I regard my single record as a fortuitous instance of picking off a loosely attached (or crawling) tick on its mammal host, even if Macdonald (1981) reports that this tyrannid gleans food from capybaras' fur. The record of the Rufous Hornero (*Furnarius rufus*) picking off ectoparasites from the skin of its capybara hosts (Tomazzoni *et al.* 2005) may well be an instance of this deft hunter catching tabanid and other flies and no ticks at all. Thus, both these passerines would require further records to confirm their supposed parasite-picking behaviour, however occasional it may be.

The tick-removing role of the Smooth-billed Ani is controversial in the literature (see Sick 1997) and I regard my single record as another fortuitous instance of tick-picking. A similar controversy about tick-removing habits surrounds the Shiny Cowbird (*Molothrus bonariensis*), although Jaramillo and Burke (1999) report that this cowbird perch on livestock and may clean them of parasites. It remains to be verified whether

this is a spatially and/or temporally localised behaviour, and whether the cowbird takes ticks or other ectoparasites such as blood-sucking flies.

On the other hand, the Giant Cowbird may be regarded as an almost, if not actually, regular cleaner (Sick 1997, Jaramillo and Burke 1999, present paper). Its behaviour on capybaras, *i.e.*, picking off ticks, pecking at sores, and catching flies, is reminiscent of that reported for buphagids (*e.g.*, Koenig 1994, Fry *et al.* 2000). To strengthen the similarity, this cowbird also dwells in open areas and in the vicinity of livestock (Sick, 1997, Jaramillo and Burke 1999). However, instead of comparing the Giant Cowbird with specialists such as oxpeckers (see Fry *et al.* 2000, Weeks 2000), it seems fruitful to point out the similarity of the cowbird with some species of the Corvidae. This is the largest cowbird (about 35 cm and 150 g, see Sick 1997) with size and mass comparable to several jays and smaller corvids (*e.g.*, Goodwin 1976, Sick 1997, Fry *et al.* 2000). Similarly to smaller corvids, the Giant Cowbird is an opportunistic forager, taking whatever sizable and edible including arthropods, fruits, and nectar from flowers (Sick 1999, Jaramillo and Burke 1999). Thus, from the ecological viewpoint, the Giant Cowbirds seems to partially play the role of some corvids (at least from the view adopted in this paper), the more so as several species of jays and crows also ride wild ungulates and livestock to peck at sores and pick off parasites (*e.g.*, Massei and Genow 1995, Fitzpatrick and Woolfenden 1996, Fry *et al.* 2000). Two species of the North American genus *Aphelocoma* ride wild ungulates and act as cleaner birds (*e.g.*, Dixon 1944, Fitzpatrick and Woolfenden 1996 and references therein), but no South American corvid is known to behave this way. Even at risk of being unduly speculative I suggest that some species of the omnivorous corvid genus *Cyanocorax* may turn to be occasional parasite cleaners of wild large herbivores and/or livestock. The Plush-crested Jay (*Cyanocorax chrysops*) is one likely candidate in Brazil, but other species that dwell in open areas and approach human settlements (Sick 1997) may occasionally step into this role as well. The strongest argument against my suggestion resides in the arboreal habits of these jays (Sick 1997), although Goodwin (1976) notes that *C. chrysops* in Paraguay would take maize grains on the ground, and other species also feed on the ground (M. A. Pizo, pers. comm.). Additionally, jays could glean arboreal, day resting and/or slow-moving mammals such as the collared anteater (*Tamandua tetradactyla*) and sloths (*Bradypus* spp. and *Choloepus* spp.).

Two broad ecological categories emerge from a glance at the Table 1 and the above remarks: 1) omnivorous scavengers and widely foraging large birds that dwell in the open, and which associate with capybaras, tapirs, and/or livestock (the Black Vulture and the Caracarina falcons), and 2) largely insectivorous, widely foraging small to large birds that dwell in the open and that also associate with capybaras and/or livestock (the Cattle Egret, the Smooth-billed Ani, the Rufous Hornero, the Cattle Tyrant, and the Giant Cowbird). The Black Caracara deviates slightly from the first category by its partly forest-

dwelling habits (White *et al.* 1994, Peres 1996, Sick 1997), and the same can be said about the White-winged Trumpeter in the second category due to its forest-dwelling habits (Peres 1996, Sick 1997). When further field observations will uncover additional species of cleaning birds, they likely will fall in one or the other of the above mentioned categories.

The postures adopted by the capybaras during the cleaning sessions by the Black Vulture (this paper) and the Yellow-headed Caracara (Tomazzoni *et al.* 2005, addendum to this paper) are reminiscent of the behavioural adjustments that some mammals and other unrelated client species including tortoises, marine turtles, and reef fishes would adopt while engaged in cleaning interactions with several cleaner types such as birds, fishes, and shrimps (*e.g.*, Marcus 1985, Massei and Genow 1995, MacFarland and Reeder 1974, Peres 1996, Grutter 2005, Grossman *et al.* 2006). Thus, the characteristic behaviour of both the vulture and the caracara and their capybara clients indicates that these two bird-mammal associations are additional instances of cleaning symbiosis (see similar views in MacFarland and Reeder 1974, Marcus 1985, Massei and Genow 1995) instead of fortuitous ectoparasite gleanings. The interactions between the Giant Cowbird and the capybaras seem to fall within the same category, even if soliciting postures by its mammal clients remain largely unrecorded. On the other hand, I regard the behaviour of the remainder parasite-picking birds reported here as occasional and/or fortuitous foraging for prey (including ectoparasites), in which the wild and/or domesticated mammal hosts are likely treated by the birds as a particular type of foraging substrate – for instance, the Cattle Tyrant is a versatile hunter able to use diverse foraging substrates and situations (Gabriel and Pizo 2005, pers. obs.) However, further observations of the behaviour of both the birds and the mammals may demonstrate that other ectoparasite-removing bird species would add to the “cleaning guild”.

ACKNOWLEDGMENTS

I am deeply grateful to Paulo Hunold Lara for the very instrumental videotaped cleaning sequence; Carlos Alberto Coutinho, Renato Cintra, and Robson Silva e Silva for the superb photographs; Marlies Sazima for the always pleasant company in the field (even if she complained about ticks); the CNPq for essential financial support.

REFERENCES

- Baber, D. W. and J. G. Morris (1980) Florida scrub jays foraging from feral hogs. *Auk* 97(2):202.
- Bella, S. D. (2003) Biologia reprodutiva e alimentar de *Bubulcus ibis* (Linnaeus, 1758) (Ciconiiforme, Ardeidae) e sua ocorrência em Pernambuco, Brasil. MSc Thesis. Recife: Universidade Federal de Pernambuco.
- Boti, J. B. (1990) Hábitos alimentares do urubu (*Coragyps atratus*) Falconiformes: Cathartidae. *Ciênc. Foco UFV* 3(9):15-18.
- Buckley, N. J. (1999) Black vulture (*Coragyps atratus*). p. 1-19. In: A. Poole and F. Gill (eds.) *The Birds of North America*, No. 411. Philadelphia: The Birds of North America, Inc. Online edition, doi:10.2173/bna.411.
- Comitê Brasileiro de Registros Ornitológicos (CBRO) (2006) Lista das aves do Brasil. Version 10/2/2006 <<http://www.cbro.org.br>> (last access January 2007)
- Côté I. M. (2000) Evolution and ecology of cleaning symbioses in the sea, p. 311-355. In: R. N. Gibson and M. Barnes (eds.) *Oceanography and Marine Biology: an Annual Review*, volume 38. London: Taylor and Francis.
- Dixon, J. S. (1944) California jay picks ticks from mule deer. *Condor* 46(4):204.
- Fisher, H. I. (1944) The skulls of the cathartid vultures. *Condor* 46(6):272-296.
- Fitzpatrick, J. W. and G. E. Woolfenden (1996) Florida scrub-jay forages on back of white-tailed deer. *Condor* 98:422-423.
- Fry, C. H., S. Keith and E. K. Urban (eds.) (2000) *The birds of Africa*, Vol. VI. London: Academic Press.
- Gabriel, V. A. and M. A. Pizo (2005) Foraging behavior of tyrant flycatchers (Aves, Tyrannidae) in Brazil. *Rev. Bras. Zool.* 22(4):1072-1077.
- Galetti, M. and P. R. Guimarães Jr. (2004) Seed dispersal of *Attalea phalerata* (Palmae) by crested caracaras (*Caracara plancus*) in the Pantanal and a review of frugivory by raptors. *Ararajuba* 12(2):133-135.
- Gonzales, J. C. (1995) *O controle do carrapato do boi*. Porto Alegre: Edição do Autor.
- Goodwin, D. (1976) *Crows of the world*. London: British Museum (Natural History).
- Griffiths, C. S. (1999) Phylogeny of the Falconidae inferred from molecular and morphological data. *Auk* 116(1):116-130.
- Griffiths, C. S., G. F. Barroughclough, J. G. Groth and L. Martz. (2004) Phylogeny of Falconidae (Aves): a comparison of the efficacy of morphological, mitochondrial, and nuclear data. *Mol. Phylog. Evol.* 32:101-109.
- Grossman, A., C. Sazima, C. Bellini & I. Sazima. (2006) Cleaning symbiosis between hawkbill turtles and reef fishes off northeast Brazil. *Chelon. Conserv. Biol.* 5(2):284-288.

- Grutter, A. S. (2005) Cleaning mutualism in the sea, p. 264-278. In: K. Rohde (ed.) *Marine Parasitology*. Collingwood: CSIRO Publishing.
- Haverschmidt, F. (1947) The black vulture and the crested caracara as vegetarians. *Condor* 49(5):210.
- Hertel, F. (1994) Diversity in body size and feeding morphology within past and present vulture assemblages. *Ecology* 75(4):1074-1084.
- Houston, D. C. (1994) Family Cathartidae (New World vultures), p. 24-41. In: J. del Hoyo, A. Elliot and J. Sargatal (eds.) *Handbook of the birds of the world*. Vol. 2. New World vultures to guineafowl. Barcelona: Lynx Edicions.
- von Ihering, R. (1946) *Da vida dos nossos animais*. São Leopoldo: Rottermund.
- Isenhardt, F. R. and D. F. DeSante (1985) Observations of scrub jays cleaning ectoparasites from black-tailed deers. *Condor* 87:145-147.
- Jaramillo, A. and P. Burke (1999) *New World blackbirds: the icterids*. Princeton: Princeton University Press.
- Koenig, W. D. (1994) Host preference, behavior, and coexistence of oxpeckers. *J. Ornithol.* 135:133.
- Lord, R. D. (1994) A descriptive account of capybara behaviour. *Stud. Neotrop. Fauna Environ.* 29(1):11-22.
- Losey, G. S. (1987) Cleaning symbiosis. *Symbiosis* 4:229-258.
- Macdonald, D. W. (1981) Feeding associations between capybaras *Hydrochoerus hydrochaeris* and some bird species. *Ibis* 123(3):364-366.
- MacFarland, C. G. and W. G. Reeder (1974) Cleaning symbiosis involving Galápagos tortoises and two species of Darwin's finches *Zeitschr. Tierpsychol.* 34:464-483.
- Marcus, M. J. (1985) Feeding associations between capybaras and jacanas: a case of interspecific grooming and possibly mutualism. *Ibis* 127(2):240-243.
- Martin, P. and P. Bateson (1986) *Measuring behaviour, an introductory guide*. Cambridge: Cambridge University Press.
- Martínez-Vilalta, A. and A. Motis (1992) Family Ardeidae (herons), p. 376-429. In: J. del Hoyo, A. Elliot and J. Sargatal (eds.) *Handbook of the birds of the world*. Vol. 1. Ostrich to ducks. Barcelona: Lynx Edicions.
- Massei, G. and P. V. Genow (1995) Observations of black-billed magpie (*Picapica*) and carrion crow (*Corvus corone cornix*) grooming wild boars (*Sus scrofa*). *J. Zool.* 236:338-341.
- Meyerriecks, A. J. (1960) Success story of a pioneering bird. *Nat. Hist.* 69:46-57.
- Payne, R. B. (1997) Family Cuculidae (cuckoos), p. 508-607. In: J. del Hoyo, A. Elliot and J. Sargatal (eds.) *Handbook of the birds of the world*. Vol. 4. Sandgrouses to cuckoos. Barcelona: Lynx Edicions.
- Peres, C. A. (1996) Ungulate ectoparasite removal by black caracaras and pale-winged trumpeters in Amazonian forests. *Wilson Bull.* 108(1):170-175.
- Rabenold, P. P. (1983) The communal roost in black and turkey vultures – an information center? p. 303-321. In: S. R. Wilbur and J. A. Jackson (eds.) *Vulture biology and management*. Berkeley: University of California Press.
- Rabenold, P. P. (1987) Recruitment to food in black vultures: evidence for following from communal roosts. *Anim. Behav.* 35:1775-1785.
- Sazima, I. (2007) Brigada de limpeza. *Terra da Gente* 3(9):12.
- Sick, H. (1997) *Ornitologia brasileira, uma introdução*. Rio de Janeiro: Editora Nova Fronteira.
- Strange, I. (1996) *The Striated Caracara* (*Phalacrocorax australis*) in the Falkland Islands. Cheshire: Philip Myers.
- Sucksdorff, A. (1985) *Pantanal, um paraíso perdido?* Rio de Janeiro: Editora Rio Gráfica.
- Tomazzoni, A. C., E. Pedó and S. M. Hartz (2005) Feeding associations between capybaras *Hydrochoerus hydrochaeris* (Linnaeus) (Mammalia, Hydrochoeridae) and birds in the Lami Biological Reserve, Porto Alegre, Rio Grande do Sul, Brazil. *Rev. Bras. Zool.* 22:713-716.
- Weeks, P. (2000). Red-billed oxpeckers: vampires or tickbirds? *Behav. Ecol.* 11(2):154-160.
- White, C. M., P. D. Olson and L. F. Kiff (1994) Family Falconidae (falcons and caracaras), p. 206-275. In: J. del Hoyo, A. Elliot and J. Sargatal (eds.) *Handbook of the birds of the world*. Vol. 2. New World vultures to guineafowl. Barcelona: Lynx Edicions.
- Witoslawski, J. J., R. B. Anderson and H. M. Hanson (1963) Behavioral studies with a black vulture, *Coragyps atratus*. *J. Exp. Anim. Behav.* 6(4):605-606.

ADDENDUM

In June 2007 I had the opportunity to record nine episodes of cleaning interactions between the Yellow-headed Caracara (*Milvago chimachima*) and capybaras (*Hydrochoerus hydrochaeris*) at the “Parque Ecológico Prof. Hermógenes Freitas Leitão Filho” Campinas, São Paulo, southeastern Brazil. The episodes took place in the afternoon (between 15:45 and

17:00 h of late austral autumn and early winter), two representative ones being described here. In one episode (1st June) I watched the capybaras resting on the bank of an islet in a large pond when I heard the characteristic call of this falconid. Soon afterwards a postjuvenile bird – with light grey to creamy bare facial skin and pale brown streaks on nape, chest, and belly – landed on the smaller capybara, a young female (Figure 9). The caracara briefly inspected the surroundings and then



FIGURES 9-14. (9) A postjuvenile Yellow-headed Caracara lands on the back of a resting capybara female; (10) the bird picks off a tick from the client's throat – compare the inviting posture of this female with the one displayed by a capybara in figure 4 (this paper); (11) the caracara on the ground pecks at an open sore on the capybara's belly; (12) the capybara male invites the caracara to clean his upper lip, from which the bird extracts a tick; (13) the male lies on his side and the bird pecks at an open sore; (14) the capybara female raises her snout and the caracara picks off a large tick – note the bird's slightly open bill.

began to walk on, and visually inspect, the capybara's back. In the first 2 min it found and picked off 5 large ticks (~1 cm diameter). The capybara soon laid on her side, exposing the belly and throat, on which the bird caught additional ticks (Figure 10). After working for a while on the capybara's flank and throat, the caracara jumped to the ground and began to scan the client's belly, on which it picked off ticks and pecked at open sores (Figure 11). Cleaning bouts were interspersed with the bird scanning its surroundings. The capybara changed her posture occasionally, behaviour similar to that recorded for these clients while cleaned by vultures (this paper). The caracara alternated its inspecting and pecking between the female and the larger male, although this latter was less receptive to the bird's activity. The bird jumped, flew, or walked from one client to another. It briefly inspected the inviting male's upper lip (Figure 12) from which it extracted a tick. After walking and pecking on the male's back and this latter lying afterwards on his side, the caracara promptly scanned it for ticks and pecked at open sores (Figure 13). Similarly to that recorded for capybaras cleaned by vultures, soliciting postures were displayed mostly when the client was already being cleaned for a while. The female received more attention from the cleaning bird than the male did, likely due to hers being more receptive and displaying soliciting postures more readily and frequently than the male. The female even stretched the neck and posed with her snout high, allowing to be cleaned on the forehead and snout (Figure 14). Both capybaras on occasions twitched the body, or jerked the legs or head, especially when the bird pecked at an open sore. The interactions began at 15:33 h and ended at 16:12 h, lasting 34 min in two sessions. The first session lasted 27 min after which the caracara flew off and was out of view for 5 min. Afterwards it landed on the lain capybara female and resumed cleaning both clients for a short additional 7 min session. Another episode (17th June) took place from 16:25 to 16:48 h at the pond bank where the capybaras were grazing. Shortly after spotting the capybaras I noticed a pair of caracaras flying over the pond, landing on isolated tree branches

near and above the capybaras, and uttering calls. Afterwards each of them landed on a capybara and began inspecting and cleaning. One of the caracaras was an adult (likely a female) accompanied by a postjuvinal, possibly the same individual seen on 1st June. The cleaning interactions were similar to those described for the first episode. Both birds inspected the capybaras for ticks and pecked at open sores, the capybaras interrupting their grazing occasionally to adopt soliciting postures. This time the male had several sores and gashes on its back and, besides deftly picking off ticks, the adult caracara ripped and swallowed two large pieces (~10 cm) of what appeared necrotic tissue, including hairs from these sores. The capybara reacted to this "rough" cleaning by jerking movements of its head towards the bird. As in the first episode, the birds interrupted their cleaning session for 7 min, flew off over the pond and remained out of sight and hearing. When they came back only the adult bird landed on the capybara male, while the young remained on a perch nearby. The adult began to call repeatedly with its head directed towards the younger bird, which soon afterwards landed beside the adult bird on the same capybara. The adult then flew to the capybara female and began to peck at her sores, while the younger bird remained on the male. The total time the caracaras stayed on the capybaras was 16 min. In five out of nine episodes the capybaras were in the open, whereas in the remainder they were in a grove. In the open the caracaras approached the capybaras on wing and landed directly on the clients' back, whereas in the cove the birds first landed on branches of nearby shrubs or trees, from which they flew to the capybaras. In the grove one of the birds once landed first on the ground and then approached the capybaras on foot. This addendum illustrates and strengthens the brief descriptions by Macdonald (1981) and Tomazzoni *et al.* (2005) for the same cleaner and client in Panama and southern Brazil, respectively. The behavioural interactions recorded for the Yellow-headed Caracara and capybaras support the idea of a well established symbiotic relationship between these two species (see discussion in this paper).