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CARCASSES REMOVAL AND REVIEW OF RECORDS OF WILDLIFE ROAD-KILL IN A PROTECTED AREA IN SOUTHERN BRAZIL

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Abstract: Herein, we describe an event of wildlife road-kill and quick carcasses removal in the Estação Ecológica do Taim (ESEC Taim), a protected area of Pampa Domain, Southern Brazil. Additionally, we provided a review of the published records on wildlife road-kill at ESEC Taim. Road surveys may be biased due to removal of carcasses from roads by factors such the presence of scavengers in open areas and traffic intensity. Thus, records of the rates at which carcasses are removed from roads are crucial for researches correcting the road-kill estimates and understanding more accurately the impact caused by road-kill on the fauna.

Keywords: bird; carcass persistence; road ecology; wetland; wildlife mortality.

The monitoring of presence of carcasses in roads has been pointed as the main data source used in studies of Road Ecology (Smith & van der Ree 2015). Therefore, to provide a better estimation regarding animal mortality on roads, the researcher ability to detect carcasses as well as the understanding of carcasses persistence time on the road are essential. Some variables can influence and explain the carcass persistence, as carcass size (Prosser *et al.* 2008), position on the road (lane or shoulder), pavement type (unpaved or paved), road type (dirt road, two-lane road or four-lane road), and traffic volume, besides weather conditions, like the presence of rainfall and air humidity (Santos *et al.* 2016). Another factor that may affect the persistence time of carcasses is the presence of scavenger animals that inhabit areas near roads (Slater 2002, Fahrig & Rytwinski 2009, Santos *et al.* 2011).

Scavenger birds are good detectors of carcasses and play an important role in removal of dead animals from the environment (Lambertucci *et al.* 2009). In preserved habitats, the abundance of birds that prey on carcasses is high (Sergio *et al.* 2006, Carrete *et al.* 2009). Herein, we reported and documented an event of wildlife road-kill and quick carcass removal by scavengers inside the area of Estação Ecológica do Taim (ESEC Taim) (32°32'19.37"S, 52°32'20.21"W), a protected area located at extreme Southern Brazil. Additionally, we provide a review on previous records of wildlife road-kill in this region, available on scientific literature.

The observation was made in December 2015,

in daytime, at BR 471 (km 502), which is a two-lane paved road that crosses for 15.7 km ESEC Taim and connects municipalities of Rio Grande and Santa Vitória do Palmar, state of Rio Grande do Sul, Brazil (Figure 1). The speed limit is 60 km/h and traffic flow is light with approximately 2,000 vehicles per day (DNIT 2017). The location is an area surrounded by wetlands, flooded grasslands and artificial channels. The event happened after an overtaking between two trucks, which resulted in 30 dead individuals at the same time (Figures 2a and 2b). These individuals contained 18 males and 12 females (Figure 3) of *Chrysomus ruficapillus* (Vieillot 1819) (Passeriformes, Icteridae), popularly known as "Chestnut-capped Blackbird". Only one individual survived after collision and was found apparently in shock on the roadside. After the road-kill event, all carcasses were removed nearly 30 minutes by *Caracara plancus* (Miller 1977) (Falconiformes, Falconidae).

Chrysomus ruficapillus is widely distributed and its occurrence area encompasses Argentina,

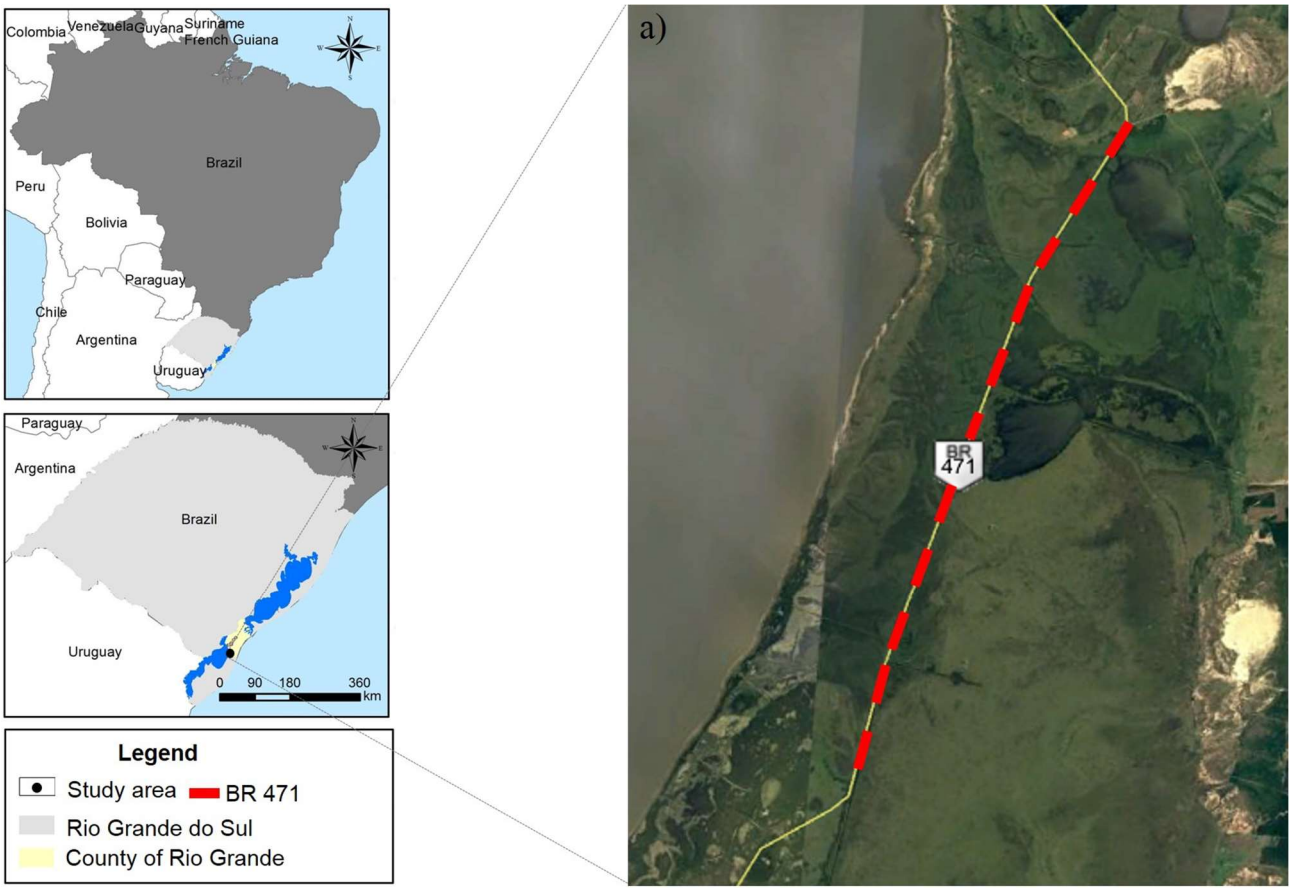

Figure 1. Localization of study area, Estação Ecológica do Taim (ESEC Taim), state of Rio Grande do Sul, Brazil. (a) Aerial image of a stretch of the highway BR 471 in the ESEC Taim.

French Guiana, Bolivia, Uruguay, Paraguay, and Brazil, including forest areas such as the Amazon Domain and open areas like the Pampa Domain (Fraga 2017). The conservation status of the species is "least concern" (IUCN 2017). They commonly live in flocks and close to rice growing areas, often associated to wetlands (Fallavena 1988). Males and females of this species weight less than 50 g and have accentuated sexual dimorphism in plumage, with males presenting a black plumage and a crown, with throat and breast red-colored, while females have brown plumage (Fraga 2017).

Studies of carcass persistence and removal have been carried out in invertebrates (Skórka 2016) and mainly in vertebrates (Flint *et al.* 2010, Santos *et al.* 2011, Ratton *et al.* 2014). The event here reported contributes to the knowledge of carcass persistence time on the roads. Our observation brings evidence that carcass persistence on roads could last for a shorter period than estimated by previous studies (Prosser *et al.*

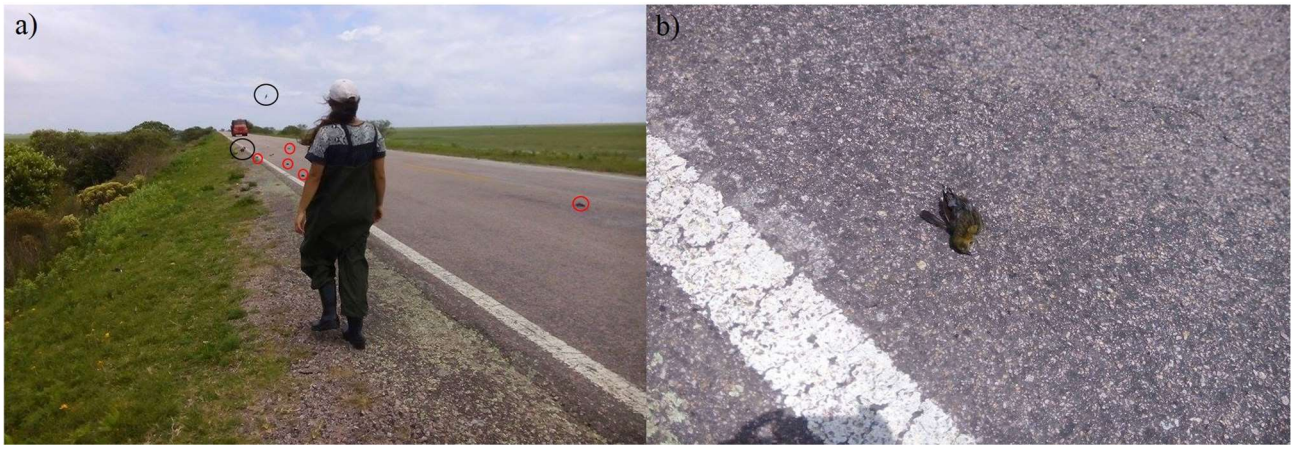

Figure 2. (a) Red circles indicate road-kill individuals of *Chrysomus ruficapillus* (Passeriformes, Icteridae) in a stretch of the BR 471 highway in the Estação Ecológica do Taim (ESEC Taim), state of Rio Grande do Sul, Brazil. Black circles indicate the presence of *Caracara plancus* (Falconiformes, Falconidae) removing the carcasses of *C. ruficapillus*. (b) Female of the *C. ruficapillus* dead in a stretch of the BR 471 highway in the ESEC Taim.

2008, Santos *et al.* 2011, Teixeira *et al.* 2013, Santos *et al.* 2016). This observation evidences the influence of carcass size on persistence time on the road (*e.g.*, Santos *et al.* 2016), as well as the influence of the presence of diurnal scavengers in open landscapes (Ratton *et al.* 2014). In addition to these factors, the fact that the event occurred on a two-lane road and with a lower traffic volume may facilitate the access of the scavengers to the carcasses, as hypothesized by Santos *et al.* (2016). The number of dead animals in this event and the permanency time of carcasses corroborate with Teixeira *et al.* (2013), where they indicate the birds as the most impacted group from vehicle–wildlife collisions.

Figure 3. Road-kill carcasses of male (black plumage with throat and breast red-colored) and female (brown plumage) of *Chrysomus ruficapillus* (Passeriformes, Icteridae) in a stretch of the BR 471 highway in the ESEC Taim, state of Rio Grande do Sul, Brazil.

Because the event occurred in a conservation unit, the high habitat quality supports a great abundance of raptors and, consequently, provides quick carcasses removal. Birds of prey are considered the main diurnal scavenger, being responsible for removing most carcass biomass (Inger *et al.* 2016). The scavenging birds have a set of adaptations related to flight and vision that allow them to find carcasses quickly and efficiently (Ruxton & Houston 2014). Besides the fact that scavenger birds are fast in removal of carcasses, they are also not repelled by traffic (Ratton *et al.* 2014). In fact, our data corroborate that both behaviors can be observed in *C. plancus*, where immediately after the collision the scavengers located and removed the entire carcasses of the highway.

The knowledge about road-kill wildlife in the ESEC Taim still remains incipient, as we found only six previous studies with records of wildlife roadlkill in this conservation unit (Novelli *et al.* 1988, Bager & Rosa 2011, Rosa & Bager 2012, Quintela *et al.* 2012, Bager & Fontoura 2013, Costa *et al.* 2015; Table 1). The bibliographic review showed that there is a gap in studies about impacts that roads promote on the local biota of ESEC Taim. Among the records of road impacts on wildlife in the ESEC Taim, the first work was published in 1988 (Novelli *et al.* 1988), which was also the first study about the theme in Brazil. Other studies were conducted only in the 2000s, a

Table 1. Road-kill records of animals in a stretch of the BR 471 highway in the Estação Ecológica do Taim, state of Rio Grande do Sul, Brazil. Conservation status followed the International Union for Conservation of Nature (IUCN 2017). NE= not evaluated.

Order / Family	Species	Common name	Conservation status	Reference
BIRDS				
Anseriforme				
Anatidae	*Coscoroba coscoroba*	Capororoca	Least concern	Bager & Fontoura (2013)
Anatidae	*Cygnus melancoryphus*	Cisne-de-pescoço-preto	Least concern	Bager & Fontoura (2013)
Anhimidae	*Chauna torquata*	Tachã	Least concern	Bager & Fontoura (2013)
Charadriiforme				
Charadriidae	*Vanellus chilensis*	Quero-quero	Least concern	Novelli *et al.* (1988), Bager & Fontoura (2013)
Laridae	*Larus maculipennis*	Gaivota-maria-velha	Least concern	Novelli *et al.* (1988)
Columbiforme				
Columbidae	*Columbina picui*	Rolinha-picuí	Least concern	Novelli *et al.* (1988)
Cuculiforme				
Cuculidae	*Guira guira*	Anu-branco	Least concern	Novelli *et al.* (1988), Rosa & Bager (2012), Bager & Fontoura (2013)
Falconiforme				
Falconidae	*Caracara plancus*	Caracará	Least concern	Bager & Fontoura (2013)
Falconidae	*Falco sparverius*	Quiriquiri	Least concern	Novelli *et al.* (1988)
Gruiforme				
Rallidae	*Gallinula chloropus*	Frango-d'água-comum	Least concern	Bager & Fontoura (2013)
Passeriforme				
Icteridae	*Chrysomus ruficapillus*	Garibaldi	Least concern	Novelli *et al.*, (1988), Bager & Rosa (2011), Rosa & Bager (2012), Costa *et al.* (2015)
Icteridae	*Leistes superciliaris*	Trinta-réis-anão	Least concern	Novelli *et al.* (1988)
Furnariidae	*Furnarius rufus*	João-de-barro	Least concern	Novelli *et al.* (1988), Rosa & Bager (2012)
Passeridae	*Passer domesticus*	Pardal	Least concern	Novelli *et al.* (1988), Rosa & Bager (2012), Bager & Fontoura (2013)

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Tyrannidae	*Pitangus sulphuratus*	Bem-te-vi	Least concern	Novelli *et al.* (1988), Rosa & Bager (2012), Bager & Fontoura (2013)
Pelecaniforme				
Ardeidae	*Ardea alba*	Garça-branca-grande	Least concern	Novelli *et al.* (1988)
Ardeidae	*Botaurus pinnatus*	Socó-boi-baio	Least concern	Novelli *et al.* (1988)
Psittaciforme				
Psittacidae	*Myiopsitta monachus*	Caturrita	Least concern	Novelli *et al.* (1988)
Strigiforme				
Strigidae	*Athene cunicularia*	Coruja-buraqueira	Least concern	Novelli *et al.* (1988)
Tytonidae	*Tyto furcata*	Coruja-da-igreja	NE	Novelli *et al.* (1988), Bager & Fontoura (2013)
Tinamiforme				
Tinamidae	*Nothura maculosa*	Codorna-amarela	Least concern	Rosa & Bager (2012)
MAMMALS				
Carnivora				
Canidae	*Cerdocyon thous*	Cachorro-do-mato	Least concern	Bager & Rosa (2011)
Felidae	*Leopardus geoffroyi*	Gato-do-mato-grande	Least concern	Bager & Fontoura (2013)
Mephitidae	*Conepatus chinga*	Zorrilho	Least concern	Bager & Rosa (2011), Bager & Fontoura (2013)
Mustelidae	*Galictis cuja*	Furão-pequeno	Least concern	Bager & Fontoura (2013)
Mustelidae	*Lontra longicaudis*	*Lontra*	Near threatened	Quintela *et al.* (2012), Bager & Fontoura (2013)
Procyonidae	*Procyon cancrivorus*	Mão-pelada	Least concern	Bager & Fontoura (2013)
Didelphimorphia				
Didelphidae	*Didelphis albiventris*	Gambá-de-orelha-branca	Least concern	Bager & Rosa (2011), Bager & Fontoura (2013), Costa *et al.* (2015)
Didelphidae	*Lutreolina crassicaudata*	Cuíca-de-cauda-grossa	Least concern	Bager & Fontoura (2013)
Lagomorpha				
Leporidae	*Lepus capensis*	Lebre-comum	Least concern	Bager & Fontoura (2013)

Table 1. Continue on next page…

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Rodentia				
Caviidae	*Cavia* sp.	Preá	Least concern	Bager & Fontoura (2013)
Caviidae	*Hydrochoerus hydrochaeris*	Capivara	Least concern	Bager & Rosa (2011), Bager & Fontoura (2013), Costa *et al.* (2015)
Myocastoridae	*Myocastor coypus*	Ratão-do-banhado	Least concern	Bager & Rosa (2011), Bager & Fontoura (2013), Costa *et al.* (2015)
REPTILES				
Squamata				
Colubridae	*Helicops infrataeniatus*	Cobra-d'água	NE	Bager & Rosa (2011), Costa *et al.* (2015)
Colubridae	*Philodryas patagoniensis*	Papa-pinto	NE	Bager & Rosa (2011)
Teiidae	*Salvator merianae*	Teiú-gigante	Least concern	Bager & Fontoura (2013), Costa *et al.* (2015)
Testudines				
Chelidae	*Phrynops hilarii*	Cágado-de-barbelas	NE	Bager & Rosa (2011)
Emydidae	*Trachemys dorbigni*	Tartaruga-tigre-d'água	NE	Bager & Rosa (2011), Bager & Fontoura (2013), Costa *et al.* (2015)

period that a lot of other Brazilian studies on Road Ecology have been started too along different regions (Bager *et al.* 2015). These papers present species of three vertebrate classes: 21 birds, 12 mammals and five reptile species (Novelli *et al.* 1988, Bager & Rosa 2011, Rosa & Bager 2012, Quintela *et al.* 2012, Bager & Fontoura 2013, Costa *et al.* 2015; Table 1). The revision of available bibliography revealed the record of *C. ruficapillus* in four of the six papers (Novelli *et al.* 1988, Bager & Rosa 2011, Rosa & Bager 2012, Costa *et al.* 2015). These studies found *C. ruficapillus* as the species with the highest number of road-kill occurrences within the group of birds.

The present paper increases our knowledge regarding Road Ecology, but also highlights the loss of wildlife caused by road-kills. The road system can result in numerous impacts in the biodiversity, being the wildlife-vehicle collisions the most evident, and it may affect the viability of populations and structure of communities (Fahrig & Rytwinski 2009, Rytwinski & Fahrig 2012). The BR 471 is a road with a low traffic volume, but with great importance for the outflow of agricultural products at the southern region of Rio Grande do Sul state, especially rice cultivation. In the stretch that crosses the ESEC Taim, educational warning signs for the reduction of road-kill were installed, besides speed reducers and radars (Bonet & Cunha 2012). Moreover, a wildlife protection system with 19 wildlife underpasses was installed in 1998, dividing the road in three sectors (Sector 1 and 3 with lateral fence; Sector 2 unfenced) along the 15.7 km of the highway BR 471 in the ESEC Taim (Bonet & Cunha 2012, Bager & Fontoura 2013). Even so, wildlife-vehicle-collisions have occurred daily in this stretch (M. L. Silveira, personal communication).

In conclusion, this study presents the first record about the impacts of road over flock birds in a protected area and serves as an important information of threat for the species. We believe that the disrespect to the speed limit by the driver of the vehicle during overtaking was the factor decisive for the occurrence of the event recorded here, the collision with the birds flock. Thus, the

use of equipment for speed reduction may be the mitigation measure more indicate to reduce road-kills of birds in highways. Finally, this record is an important contribution that can be used in meta-analysis works in order to determine temporal variations in road-kills for birds and especially to *C. ruficapillus*.

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