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Incidence of Cartwheeling Flights in Raptors of South-Central Chile

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ABSTRACT.—Cartwheeling flight is a behavior that involves aerial locking of talons by raptors followed by a descending mutual rotation around a central axis, like a cartwheel. We provide information on 32 recorded cartwheeling events from south-central Chile involving 12 raptor species; 26 were by dyads of the same species, of which 61.5% were associated with aggressive events. Only one case was considered a courtship behavior and two as play. *Milvago chimango* was the most frequently involved in intraspecific cartwheeling (38.5%), whereas *Geranoaetus polyosoma* had the highest frequency of allospecific encounters (67%). This is the first account on the occurrence of cartwheeling flights in South American raptors, and we suspect that this behavior is more prevalent than has been reported previously. Received 7 August 2014. Accepted 22 November 2014.

Key words: aggression, agonistic behavior, Chile, *Geranoaetus polyosoma*, *Milvago chimango*, raptors, talon-grappling.

A cartwheeling flight is a combination of behaviors that involve the aerial locking of the talons of two raptors, known as “talon-grappling” or “talon-locking” followed by a downward

mutual rotation around a central axis similar to a cartwheel (Simmons and Mendelsohn 1993, Farquhar et al. 1994). During the vertical fall, the birds either separate from each other or crash into an object or to the ground (Simmons and Mendelsohn 1993). Given that not all talon grapplings are followed by cartwheeling, these terms are treated differently by some authors (see Simmons and Mendelsohn 1993, Farquhar et al. 1994).

The talon contact in flight and cartwheeling between two raptors has generally been reported intraspecifically and interpreted as aggression, courtship, play, and aerial prey transfer (e.g., Brown and Amadon 1968, Johnsgard 1990, Simmons and Mendelsohn 1993, Kitowski 2001, Seipke and Cabanne 2002, Borello and Borello 2004, Hengstenberg and Vilella 2005, Murn et al. 2009). To a lesser extent, it has been reported interspecifically and interpreted as an aggressive behavior to defend a breeding or hunting territory (e.g., Simmons and Mendelsohn 1993, Farquhar et al. 1994, Figueroa Rojas 2003, Hopkins et al. 2009).

Although this behavior has been widely reported to occur in raptors in Nearctic (North America; Watson 1940, Kilham 1981, Craig et al. 1982, Clark 1984, Arndt 1995, Hopkins et al. 2009) and Afrotropical (Africa; Brown and Amadon 1968, Simmons and Mendelsohn 1993 [and references therein], Boix-Hinzen and Witts 2002, Borello and Borello 2004, Murn et al. 2009) zoogeographical zones, scant and isolated reports have come from the Neotropics (Central and South America; Ellis 1992, Farquhar et al. 1994, Seipke and Cabanne 2002, Figueroa Rojas 2003, Valdez and Osborn 2004, Hengstenberg and Vilella 2005, Méndez-Mojica 2012, Norambuena et al. 2012, Leveau 2013). In particular, long-term behavioral and breeding studies from Chile have not reported cartwheeling between interacting raptors (Jiménez and Jaksić 1989, 1991, 1993; Rivas-Fuenzalida et al. 2011, 2013), with the exception of Figueroa Rojas (2003) and Norambuena

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et al. (2012). Here, we present a review of first-hand records of cartwheeling between raptors in south-central Chile, with the aim of recognizing patterns and interpreting its behavioral role between conspecifics or allospecies.

METHODS

Observations and Interpretations.—Records of cartwheeling mostly came from first-hand and non-published observations obtained by the authors while conducting raptor and non-raptor research in south-central Chile. Additionally, we interviewed 26 field researchers including raptor biologists, professional birdwatchers, nature photographers and serious amateurs, as well as two published reports (Figuroa Rojas 2003, Norambuena et al. 2012). We did not consider cartwheeling cases in which only talon-grappling or talon-locking was involved. For each record, we requested and noted: (1) the participant species, (2) date, (3) locality, (4) relative age of birds when possible (i.e., juvenile, immature, or adult), (5) sex, (6) number of turns while locked, (7) whether they crashed into an object or the ground, and (8) an interpretation of the observation (see below). Our interpretations of the behaviors considered the activities before and after cartwheeling, the relative age and sex of the interacting birds. For the records from interviews of other observers, we re-evaluated each interpretation according to the requested information. We categorized the behaviors following Simmons and Mendelsohn (1993) and Kitowski (2001) as: (a) courtship, (b) aggression, (c) play, (d) aerial prey transfer, (e) without interpretation, and (f) unknown. Courtship behavior was defined as occurring during the breeding season (austral spring and summer), and involving adult birds of different sex. We classified a record as “without interpretation” when we had insufficient evidence and as “unknown” when the observer did not provide an interpretation nor evidence for critically interpreting the interaction (Simmons and Mendelsohn 1993).

For species with color sexual dimorphism, we assigned sex according to the descriptions of Ferguson-Lees and Christie (2001), complementing these with the information reported by Pavez (1998) and Sarasola et al. (2011). For monochromatic species we could assign sex only to pairs that were systematically monitored (e.g., Norambuena et al. 2012) or for pairs in

which reverse sexual dimorphism was notorious. Nomenclature followed Remsen et al. (2014).

RESULTS

Cartwheeling Interactions in South-central Chile.—We compiled information from 32 cartwheeling events, of which 30 were new observations. These interactions occurred among 12 raptor species, mainly in Accipitridae ($n = 7$) and to a lesser extent in Falconidae ($n = 3$), Cathartidae ($n = 1$), and Strigidae ($n = 1$). Most interactions were intraspecific (26 of 32; Table 1), whereas few were interspecific (6 of 32; Table 2). The number of turns were higher and more variable in intraspecific events, being the highest among adult birds (see Table 1). Of the total recorded behaviors ($n = 32$), 22 cases were interpreted as aggression, two as play, one as courtship, and seven without interpretation. None involved prey transfer and seven ended with the birds crashing on the ground or on a tree, without apparent injury or deaths of the birds.

Intraspecific Cartwheeling Interactions.—Chimango Caracara (*Milvago chimango*) was the species with the most intraspecific cartwheeling cases reported ($n = 10$), followed by Variable Hawk (*Geranoaetus polyosoma*; $n = 4$), Black-chested Buzzard-Eagle (*G. melanoleucus*; $n = 3$), and Southern Caracara (*Caracara plancus*; $n = 3$). We detected one or two cases occurring in Black Vulture (*Coragyps atratus*), Harris’s Hawk (*Parabuteo unicinctus*), White-tailed Kite (*Elanus leucurus*), and Cinereous Harrier (*Circus cinereus*) (Table 1). Most of the interactions (16 of 26, or 61.5%) were interpreted as aggressive, one of which was confirmed to occur when defending prey remains on the wing (attempt of kleptoparasitism in *C. plancus* close to Mano Negra, in Aysén administrative Region; see details in Table 1). Only one cartwheeling flight was considered as a courtship behavior. This occurred in an adult pair of *G. melanoleucus* within an active territory used for several breeding seasons (having three nests within 200 m) and during the courtship period for that latitude (Table 1). Courtship chases and synchronized flights were observed previous to cartwheeling flights in this pair, and mating was observed two weeks after the event.

In at least eight of the cases, we confirmed the involvement of juvenile birds; in six, juveniles interacted with adults (Fig. 1A–B) and in two,

TABLE 1. Intraspecific cartwheeling interactions in raptors of south-central Chile.

Species	Date	Locality	Coordinates	Relative age ^a	Sex ^b	Interpretation ^c	Number of turns	Crash (tree or ground)	Observer or Reference ^d
Cathartidae									
<i>Coragyps atratus</i>	Feb 2004	Contulmo, Biobío Region	37°54'S, 73°16'W	?, ?	?, ?	U	4	N	TR
Falconidae									
<i>Milvago chimango</i>	Jul 2003	Cañete, Biobío Region	37°48'S, 73°24'W	A, J	?, ?	A	3	N	TR
<i>M. chimango</i>	Nov 2003	Cañete city, Biobío Region	37°48'S, 73°24'W	A, A	?, ?	U	8	Y	TR
<i>M. chimango</i>	12 Aug 2006	Huechuraba, Santiago, Metropolitan Region	33°22'S, 70°38'W	A, A	?, ?	U	15–20	Y	JT
<i>M. chimango</i>	Nov 2009	Temuco, Araucanía Region	38°45'S, 72°37'W	?, ?	?, ?	U	4	N	HN
<i>M. chimango</i>	15 May 2010	Lolen River, Lonquimay Valley, Araucanía Region	38°27'S, 71°13'W	?, ?	?, ?	U	2	N	VR and HN
<i>M. chimango</i>	Aug 2011	Pueblo Nuevo, Temuco city, Araucanía Region	38°42'S, 72°33'W	A, J	?, ?	A	5	N	AG
<i>M. chimango</i>	6 Mar 2013	Puerto Cisnes, Aysén Region	44°43'S, 72°40'W	J, A	?, M	A	2	Y	VR
<i>M. chimango</i>	Oct 2013	Puente Alto, Metropolitan Region	33°37'S, 70°34'W	A, A	?, ?	U	8–10	Y	JT
<i>M. chimango</i>	10 Feb 2014	Raúl Marín Balmaceda, Aysén Region	43°47'S, 72°56'W	J, J	?, ?	P	2	Y	VR
<i>M. chimango</i>	6 Jun 2014	Puyuhuapi, Aysén Region	44°19'S, 72°33'W	?, ?	?, ?	U	3	N	VR
<i>Caracara plancus</i>	5 Jan 2014	Diana Lagoon, Magallanes Region	51°55'S, 72°25'W	A, A	?, ?	A	2	N	JD
<i>C. plancus</i>	1 May 2014	10 km of Puerto Natales, Magallanes Region	51°46'S, 72°27'W	A, J	?, ?	A	1	N	JD
<i>C. plancus</i>	10 May 2014	Mano Negra near Villa Ortega, Aysén Region	45°21'S, 71°59'W	A, A	?, ?	A	2	N	VR
Accipitridae									
<i>Geranoaetus polyosoma</i>	12 Dec 1998	Lagumillas, Santiago, Metropolitan Region	33°21'S, 70°14'W	A, A	M, M	A	3	N	DM
<i>G. polyosoma</i>	15 May 2010	Lolen River, Lonquimay Valley, Araucanía Region	38°27'S, 71°13'W	A, J	M, ?	A	3	N	VR and HN

TABLE 1. Continued.

<i>G. polyosoma</i>	24 Nov 2010	Farellones, Metropolitan Region	33°21'S, 70°18'W	A, A	M, M	A	12-18	N	JT
<i>G. polyosoma</i>	27 Mar 2012	Mocho-Choshuenco Volcano, de los Ríos Region	39°57'S, 72°04'W	A, A	M, F	A	3	N	TR
<i>G. melanolencus</i>	Oct 2003	Palomares Hill, Magallanes Region	52°42'S, 71°21'W	A, A	M, F	C	6	N	AK
<i>G. melanolencus</i>	23 Mar 2013	Castillo Hill, Magallanes Region	51°22'S, 72°45'W	A, A	?, ?	A	4-5	N	JD
<i>G. melanolencus</i>	23 Oct 2013	Castillo Hill, Magallanes Region	51°22'S, 72°45'W	A, A	?, ?	A	>4	N	JD
<i>Parabuteo unicinctus</i>	Sept 2010	Contulmo, Biobio Region	38°02'S, 73°12'W	A, A	M, M	A	17	N	TR
<i>P. unicinctus</i>	22 Mar 2014	El Natri, Contulmo, Biobio Region	37°5'S, 73°17'W	J, J	M, M	P	6	N	TR
<i>Elanus leucurus</i>	7 May 2011	Talcahuano, Biobio Region	36°44'S, 73°02'W	A, J	?, ?	A	6	N	EW
<i>E. leucurus</i>	Jun 2011	Mariposas Hill, Araucania Region	38°42'S, 72°33'W	A, A	?, ?	A	7	Y	AG
<i>Circus cinereus</i>	Jan 2012	Fundo el Carmen, Temuco city, Araucania Region	38°42'S, 72°39'W	A, A	F, F	A	4	Y	AG

^a Relative age: A = Adult, J = Juvenile, ? = Unknown

^b Sex: M = Male, F = Female, ? = Unknown

^c Interpretation: A = Aggression, P = Play, C = Courship and U = Uninterpretable

^d Observer or Reference: AG = Alvaro García, AK = Alejandro Kusch, DM = Daniel Martínez, EW = Egon Wolf, HN = Heraldo Norambuena, JD = José Díaz, JT = Jorge Toledo, TR = Tomás Rivas, VR = Víctor Raimilla.

TABLE 2. Interspecific cartwheeling interactions in raptors of south-central Chile.

Species (species 1 x species 2)	Date	Site	Coordinates	Relative age ^a	Sex ^b	Interpretation ^c	Number of turns	Crash (on tree or ground)	Observer or Reference ^d
<i>G. polyosoma</i> x <i>Buteo albigula</i>	3 Feb 2002	Natural Reserve, Ñuble, Biobío Region	35°40'S, 71°20'W	A, A	?, ?	A	3	N	Figueroa Rojas (2003)
<i>G. polyosoma</i> x <i>B. ventralis</i>	21 Nov 2009	Cerro Nielol Natural Monument, Temuco, Araucanía Region	38°43'S, 72°35'W	A, A	M, F	A	3	N	Norambuena et al. (2012)
<i>G. polyosoma</i> x <i>B. ventralis</i>	Jun 2010	Mariposas Hill, Araucanía Region	38°41'S, 72°33'W	A, ?	F, ?	A	2	N	AG
<i>G. polyosoma</i> x <i>G. melanoleucus</i>	18 Nov 2010	Lonquimay Valley, Araucanía Region	38°27'S, 71°16'W	A, A	M, ?	A	3	N	VR
<i>Asio flammeus</i> x <i>C. cinereus</i>	Nov 2011	Diana, Magallanes Region	51°51'S, 72°01'W	A, ?	?, ?	A	3-4	N	AK
<i>E. leucurus</i> x <i>Falco femoralis</i>	18 Oct 2013	Batuco, Metropolitan Region	33°13'S, 70°49'W	A, I	?, ?	A	5	N	SB

^a Relative age: A = Adult, J = Juvenile, ? = Unknown

^b Sex: M = Male, F = Female, ? = Unknown

^c Interpretation: A = Aggression, P = Play, C = Courtship and U = Uninterpretable

^d Observer or Reference: AG = Alvaro García, AK = Alejandro Kusch, SB = Sergio Bitrán, VR = Victor Raimilla



FIG. 1. Intraspecific cartwheeling interactions between a) an adult and a juvenile *Elanus leucurus* (photo by E. Wolf) and b) *Milvago chimango* that ended crashing on a tree (photo by V. Raimilla).

both birds were juveniles. These latter, involving *M. chimango* and *P. unicinctus* were interpreted as playful behaviors (Table 1). The pair of *M. chimango* were brothers of parents that raised four juveniles at Raúl Marín Balmaceda. This family was closely observed with 10 x 40 binoculars. In one of the chases of two juveniles close to the ground (<6 m), they locked talons and performed two turns before crashing to the ground. After the crash, one of the juveniles continued playfully chasing another brother, while the other bird remained standing on the ground until the end of the observation. For the *P. unicinctus* pair, we hypothesized that the birds were brothers given that the nearest conspecific nest was ~3 km away.

Interspecific Cartwheeling Interactions.—In four of the six (67%) interspecific cartwheeling interactions, a *G. polyosoma* participated (Table 2). These involved a *G. melanoleucus* ($n = 1$) and Rufous-tailed Hawks (*Buteo ventralis*; $n = 2$) when the *G. polyosoma* defended their breeding territories, likely influenced by the proximity of the active nests of the other raptors: 0.7 km for the *B. ventralis* and 0.4 km for the *G. melanoleucus*. The only case of a strigiform involved in cartwheeling was a Short-eared Owl (*Asio flammeus*) interacting with a *C. cinereus*, the former defending its territory (Table 2). Further, we observed a cartwheeling interaction that was an attempt to steal prey (kleptoparasitism) by an immature Aplomado Falcon (*Falco femoralis*) from an adult *E. leucurus* (Fig. 2).

DISCUSSION

Cartwheeling Interactions in South-central Chile.—To our knowledge, we documented the first case of cartwheeling for *C. atratus*, *P. unicinctus*, *C. cinereus*, *C. plancus*, and *A. flammeus* (cf., Jiménez and Jaksic 1988, Johnsgard 1990, Simmons and Mendelsohn 1993, Saggese and De Lucca 1995, Engh et al. 1997, Simmons 2000, Dwyer and Bednarz 2011, Salvador 2013). In agreement with that reported by Simmons and Mendelsohn (1993), most of our cartwheeling cases were associated with aggressive behavior and occurred between intraspecific individuals.

Intraspecific Cartwheeling Interactions.—Previously, Leveau (2013) reported a cartwheeling case for *M. chimango* in the city of Mar del Plata, in Argentina. However, he did not provide an



FIG. 2. Interspecific cartwheeling interactions between an immature *Falco femoralis* and an adult *Elanus leucurus* associated with an attempted prey robbery (kleptoparasitism) by the *F. femoralis* (photo by S. Bitrán).

interpretation for this behavior. Although most of the cartwheeling behavior in *M. chimango* occurred during the breeding period (Sept–Jan; Morrison and Phillips 2000), our interpretation of this behavior was incomplete, because we could not determine sex and age of the birds. Thus, we could not determine if it was a territorial dispute, or courtship behavior (Brown and Amadon 1968).

M. chimango is one of the most abundant raptors in southern South America both in agricultural landscapes and in urban areas (Donázar et al. 1993, Jaksic et al. 2001). It is likely that this high abundance resulted in the frequent recording of the cartwheeling behavior that we detected. Additionally, *M. chimango* is a species that shows a gregarious foraging behavior and breeds semi-colonial or colonially (Fraga and Salvador 1986, Josens et al. 2013), thereby likely increasing or facilitating the agonistic and play cartwheeling behavior between conspecifics (see Biondi et al. 2010). The mentioned behavior of this species provides an ideal model to study cartwheeling flights and identify their function.

Cartwheeling has been described as part of the courtship behavior in large eagles (Brown and Amadon 1968, Seipke and Cabanne 2002, Borello and Borello 2004, Valdez and Osborn 2004, Murn et al. 2009). Although for *G. melanoleucus*, circular soaring flights and persecutions have been reported as pair courtship behavior (Jiménez and Jaksic 1990, Pavez 2001), cartwheeling flights have not been described as a courtship behavior and thus, this is the first case documented for this species.

Given that all the observations that involved juvenile birds interacting with adults occurred during the juvenile dispersal period (Jan–Sept), the talon-locking and the subsequent cartwheeling could be an aggressive behavior of the adult to chase away the juvenile.

Interspecific Cartwheeling Interactions.—*G. polyosoma* is one of the most aggressive of the larger raptors, especially when defending its hunting and nesting territories (Jiménez and Jaksic 1991, Jiménez 1995). Figueroa Rojas (2003) interpreted a cartwheeling interaction between a *G. polyosoma* and a *B. albigula* as a territorial defense by the latter. This may explain the cartwheeling behavior with larger but shy species, such as *B. ventralis* (see behavior in Trejo et al. 2006). The cartwheeling behavior in *G. polyosoma* with other raptors of similar or larger size (see also Farquhar et al. 1994, Figueroa Rojas 2003) may indicate that larger species elicit

more aggressive reactions especially against smaller raptors (Jiménez and Jaksic 1989, Baladrón and Pretelli 2013).

M. chimango and American Kestrel (*F. sparverius*) are the smallest raptors that most frequently start agonistic interactions with raptors of medium or large size in southern South America (Jiménez and Jaksic 1989, De Lucca 2011, Baladrón and Pretelli 2013). However, there are no reports of interspecific cartwheeling involving these species in South America. Perhaps it would not be advantageous for a small raptor to be involved in such a risky behavior that can result in deadly injuries or depredation (see Alvarado Orellana 2008, Bierregaard et al. 2013).

To our knowledge, here we report for the first time a cartwheeling behavior between *A. flammeus* and *C. cinereus*. Given that these species coexist in open habitats, often nest in the same wetland (Jaksic et al. 2002), and that the only recorded event was during the breeding period, when both species are highly territorial and aggressive, it seems likely that interactions between these raptors may respond to nest defense behavior.

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