

Parental care and time-activity budget of a breeding pair of Black-chested Buzzard-eagles (*Geranoaetus melanoleucus*) in southern Patagonia, Argentina

Cuidado parental y actividad diaria de una pareja anidante de Águilas Moras (*Geranoaetus melanoleucus*) en la Patagonia Sur, Argentina

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Abstract

We investigated the parental care and time-activity budget of a breeding pair of Black-chested Buzzard-Eagles (*Geranoaetus melanoleucus*) in southern Patagonia, Argentina. Female and male shared daytime incubation (male 30.3%, female 69.7%), but the female was responsible for a larger percentage in the middle and late stages of incubation. Two chicks hatched, only one of which (a female) survived after days 8-12 of the nestling period and fledged at 56 days. In the nestling period, the female spent 62.2% of her time attending the nest, vs. 10.9% for the male. During this period, prey for the female and nestling(s) was almost exclusively delivered by the male ($n=46$, 95.8%). The female delivered prey to the nestling only twice, between days 31 and 40. The male did not reduce his provisioning rate during later stages of the nestling period. The female performed most of the feeding of the offspring. After the nestling was >40 days old, the parents nearly stopped feeding it. Overall, results of this study are consistent with the division of labor between the sexes observed in other large mammal- and bird-eating raptors from temperate regions outside of the Neotropics. However, in this pair the female did not become a significant prey-provider during the second half of the nestling period; the male was almost the only food provider. Further studies should examine a larger number of nests to determine if this is a common behavior in this species or unique to this pair. Moreover, the role that biotic (brood size, age of adults, food availability, competition with other predators) and abiotic (day length, topography, weather) factors may have in the parental care and time-activity budget of Black-chested Buzzard-Eagles across its complete range should be investigated.

Key words: Black-chested Buzzard-Eagles, *Geranoaetus melanoleucus*, parental care, Patagonia, time-activity budget

Resumen

Investigamos el cuidado parental y la actividad diaria de una pareja anidante de Águilas Moras (*Geranoaetus melanoleucus*) en la Patagonia Sur, Argentina. La incubación estuvo a cargo del macho (30.3%) y de la hembra (69.7%), pero la hembra fue la principal encargada de la incubación luego del primer tercio del período. De los dos pichones nacidos, uno murió entre los días 8 y 12, mientras que el otro, una hembra, sobrevivió y abandonó el nido a los 56 días de edad. En el período de crianza en el nido la hembra dedicó 62.2% de su tiempo a atender el mismo mientras que el macho solo consagró un 10.9% de su tiempo a esta actividad. En este período, el aporte de presas estuvo casi exclusivamente a cargo del macho ($n=46$, 95.8%). La hembra aportó presas únicamente en dos ocasiones, entre los días 31 y 40 del período de crianza en el nido. El macho no disminuyó el ritmo de aporte de presas durante los estadios finales de este período. La alimentación de los pichones fue casi actividad exclusiva de la hembra. A partir de los 40 días de edad los adultos ya no alimentaron al pollo sobreviviente. En general, los resultados de este estudio concuerdan con la división de labores observada en machos y hembras de aves rapaces consumidoras de mamíferos y aves que habitan áreas templadas no neotropicales. Sin embargo, opuesto a lo que ocurre en estas otras especies no neotropicales, en esta pareja de *G. melanoleucus* el papel de la hembra como proveedora de alimento durante la segunda mitad del período de crianza fue prácticamente nulo. Futuros estudios del cuidado parental y actividad diaria de la especie deberán examinar un mayor número de nidos para así poder determinar si esto es

común para la especie o un fenómeno exclusivo de esta pareja. Además, se deberá investigar el papel que factores bióticos (tamaño de la postura, edad de los adultos, disponibilidad de alimento, competencia con otros depredadores) y abióticos (extensión del período de horas luz, clima, topografía) pueden tener en determinar el cuidado parental y actividad diaria de *G. melanoleucus* en toda su distribución geográfica.

Palabras clave: Actividad diaria, Águila mora, *Geranoaetus melanoleucus*, cuidado parental, Patagonia

Introduction

Comparative studies of the breeding behavior of raptors indicate that species feeding on insects, invertebrates and reptiles have reduced sex-based division of labor during the breeding period compared to species preying on mammals and birds, such as Buteonine hawks, *Accipiter* hawks, larger falcons and eagles (Newton 1979, Olsen 1995, Gaibani & Csermely 2007). In species preying on mammals and birds, males and females have different roles during different stages of the nesting season; males usually are the main food providers during pre-incubation, incubation and early stages of chick development, whereas females are mainly responsible for incubation of the eggs and brooding of the nestlings (the prey-partitioning hypothesis; Newton 1979, Olsen 1995, Simmons 2000). In later stages of the nestling period when food demands increase, females increase the time they spend hunting and providing food to nestlings (Newton 1979, Olsen 1995, Simmons 2000, Gaibani & Csermely 2007). Most of the information on breeding behavior, parental care and time-activity budgets of large raptors that eat mammals and birds comes from studies conducted on Nearctic, Palearctic, African and Australasian species (Brown 1977, Newton 1979, Cramp & Simmons 1980, Palmer 1988, Olsen 1995). The amount of behavioral information available for Neotropical raptors is minimal (Bierregaard 1995, Trejo 2007).

The Black-chested Buzzard-eagle (*Geranoaetus melanoleucus*) ranges from Venezuela and Colombia to Tierra del Fuego in southern Argentina and Chile (Jimenez & Jaksic 1990). It is one of the

largest Buteonine raptors inhabiting open, temperate areas of South America (Jimenez & Jaksic 1990). Reversed sexual dimorphism is marked in this species (Jimenez & Jaksic 1990). Its prey are small- and medium-sized mammals along most of its range (Jimenez & Jaksic 1990, Pavez *et al.* 1992, Trejo *et al.* 2006, but see also Zorzín *et al.* 2007 and Salvador *et al.* 2008 who described birds as its main prey in Brazil). In Argentina, the Black-chested Buzzard-Eagle is commonly found in Patagonian steppes, coastal areas, and savanna woodlands (Jimenez & Jaksic 1990). It is considered a common, non-threatened species throughout its range, although local human persecutions, collisions with power lines and poisonings have been reported (De Lucca & Saggese 1989, 1995, Bellati 2000, Alvarado & Roa 2010). Elements of the behavioral ecology, agonistic behavior and habitat selection of the species have been reported (Jimenez & Jaksic 1989, Farquhar *et al.* 1994, Bustamante *et al.* 1997, Salvador *et al.* 2008). Its breeding ecology and nesting ecology have been extensively studied along its distribution in Argentina, Chile, Peru, Ecuador and Brazil (Schoonmaker 1984, Sierra 1985, Jimenez & Jaksic, 1990, Hiraldo *et al.* 1995, Travaini *et al.* 1994, De Lucca & Saggese 1995, Donázar *et al.* 1996, Cardozo De Souza 1999, Pavez 2001, Saggese & De Lucca 2001, 2004, Zorzín *et al.* 2007, Salvador *et al.* 2008). However, detailed observations of parental care and time-activity budgets have not been reported. In this study we examine the parental care and time-activity budget of a breeding pair of Black-chested Buzzard-Eagles in Santa Cruz province, a temperate area in southern Patagonia, Argentina.

Methods

The study was conducted from 20 Sep 1987 to 5 Jan 1988 (Patagonian spring and early summer) in Estancia El Cuadro, Department of Deseado, Santa Cruz Province, Argentina (47°30'S, 68°10'W), approximately 150 km west of Puerto Deseado and 135 km from Jaramillo and Fitz Roy, the closest towns by road. The study area is located in the Central Patagonia District within the Patagonian Province phytogeographic region (Cabrera 1976). Topography is characterized by a succession of mesas, cliffs, valleys, and small canyons. Elevation ranges from 150 to 290 m. The vegetation is typical of the Central Patagonia District, dominated by tussock grasses (*Stipa* spp., *Poa* spp.) and small shrubs such as Algarrobo Patagónico (*Prosopis denudans*), Molle (*Schinus* sp.), Quilembay (*Chuquiraga avellanedae*), and Calafate (*Berberis cuneata*) (Cabrera 1976). Wet meadows (locally called *mallines*) and small ponds formed by rainfall and natural springs are found scattered in the valleys. During 1987-1988 sheep ranching was the main human activity in the study area; the vegetation showed severe signs of overgrazing. Several aspects of the breeding ecology of Black-chested Buzzard-Eagles and additional characteristics of the study area have been described elsewhere (De Lucca & Saggese 1995, Saggese & De Lucca 1995, 2001, 2004).

We monitored one pair of eagles from a blind located 70 m from the nest and used 7 X and 10 X 50 binoculars for detailed observations and quantification of the parental care and time-activity budget. Observations covered a total of 374 h 17 min (22,457 min) of direct monitoring using an animal and nest focal technique (Lehner 1979). Observations were conducted at randomly selected periods and times of day, from sunrise to sunset. In spring observations started at 07:00 h and ended by 19:00 h; near the summer solstice we conducted observations from 06:00 to 21:30 h.

Both members of the pair were in adult plumage and sexes were easily identified while flying, perching or incubating by unique plumage characteristics (missing feathers), and size and color patterns of under-wing coverts, breast and abdominal feathers. Breeding periods were determined by direct observation of adult behaviors and by the presence of eggs and chicks in the nest. Behaviors, time and activity budgets were recorded during three different nesting periods of the nesting season defined as: (1) pre-incubation period (from 23 Sep to 7 Oct, total 2,276 min), (2) incubation period (from 8 Oct to 12 Nov, total 8,781 min [further divided into early, mid-, and late incubation stages of 3,960, 2,550 and 2,271 min, each 12 days long]) and (3) nestling period (from 13 Nov to 2 Jan, total 11,400 min). This last period was separated into two early nestling stages of 10 days each (days 1 to 10, 2,390 min and days 11 to 20, 2,839 min) and two later nestling stages of 10 days each (days 31 to 40, 4,226 min and days 41 to 50, 1,945 min). No observations were conducted between days 21 and 30.

Nesting material delivery and prey provisioning rates were defined as the number of events per hour of observation. Additional details of behavior were recorded and categorized for adults and the single nestling. Activity is expressed here as percentage and/or as a rate of events (*e.g.* feeding or mating events) per hr of the total observation time for the whole study or for each period/stage as defined above. For each member of the pair, events included: time spent away from the nesting cliff (out of sight, *e.g.*, hunting) perching on the nesting cliff (rocks and trees), incubating, providing nest material, brooding, standing on the nest, feeding (itself, nestling or mate).

Results

Pre-incubation period. By the time our observations began at the initiation of this study, the pair

spent most of their day time flying and performing courtship and territorial displays (66.5% and 81.8% of the daily time for the female and male, respectively). The female spent more time at the nest (11.8%) and perching at the nesting cliff (21.6%) than the male (1.1% and 17.1%, respectively). Both members of the pair were seen together at the nest during 0.6% of this period. The nest was left unattended 87.7% of this time. Yellow tussock grasses were delivered to the nest by both members on 12 occasions (0.32 deliveries per h); the male made 5 (41.6%) and the female 7 (58.3%) of them. Copulation was observed on five occasions in this period at a rate of 0.13 mating events per hour (Saggese & De Lucca 2001).

Incubation period. We first observed incubation and confirmed a clutch of two eggs on 8 October. The female spent 65.0% of the time at the nest, 88.1% of this time incubating and overall being responsible for 69.7% of the time eggs were incubated. She spent the remaining time out of the nest feeding and gathering nesting material (31.0%) or perched on the nest cliff (3.9%). The male spent 35.4% of this period at the nest, 85.6% of this time incubating and overall being responsible for 30.3% of the time eggs were incubated. He spent the remaining time perching at the nest (5.1%), perching on the nesting cliff (10.7%) and flying or out of sight (53.9%). The nest was unattended only 1.3% of this period (Fig. 2).

During the early incubation stage the male participated more in incubation than in later stages (Figs. 1 and 2). In contrast, the percent of time the female spent incubating increased from the first to the second stage and then decreased at the end (third stage) of this period, when temperatures were extremely high and sun rays pointed directly on the nesting cliff (Fig 1.). The male spent substantial time away from the nesting cliff and this absence steadily increased during the incubation period (Fig. 3). As incubation progressed, the fe-

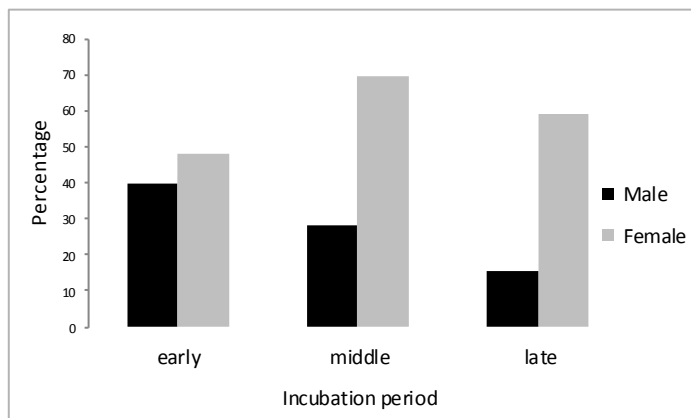


Figure 1. Percentage of daytime spent incubating by sex in a pair of *Geranoaetus melanoleucus* during three stages of the incubation period.

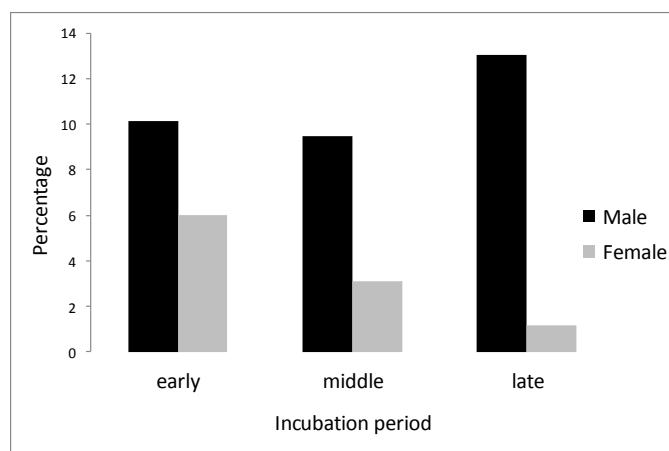


Figure 2. Percentage of daytime spent perching on the nesting cliff by members of a pair of *Geranoaetus melanoleucus* during three stages of the incubation period.

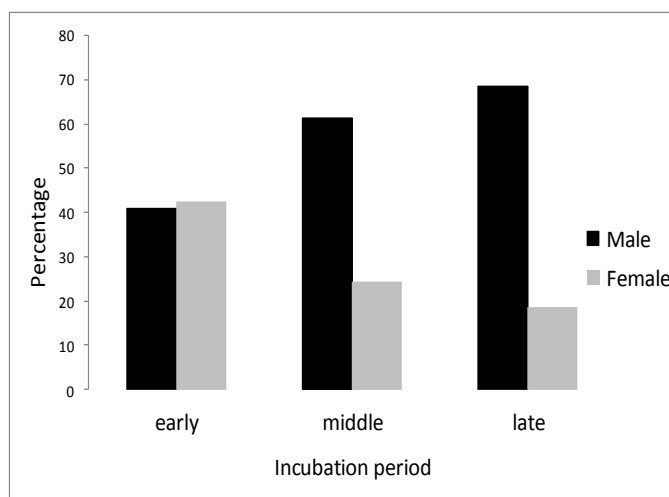


Figure 3. Percentage of daytime spent away from the nesting cliff by members of a pair of *Geranoaetus melanoleucus* during three stages of the incubation period.

male spent less time away from the nest cliff and less time perched on the cliff, spending most of her time incubating (Figs. 1-3). During the incubation period the parents delivered yellow, dry, tussock grass to the nest on 20 occasions, at a rate of 0.136 deliveries per hour. The female contributed materials on 15 (75%) occasions and the male five (25%) times.

Nestling period. Two chicks hatched at this nest; one of them disappeared between 8 and 12 days of age, and the other fledged at 56 days. The single offspring that fledged was a female, as determined morphometrically (Saggese & De Lucca 2001) at the end of the study. During the nestling period the adult female spent most of her time at the nest (62.2%). The remaining time was spent perching on the nesting cliff (14.1%) or either flying near the nesting site and flying or performing other activities out of sight (23.7%). In contrast, the male spent only 10.9% of his time at the nest; the remainder of his time was spent either perching on the nesting cliff (15.6%) or flying near the cliff and out of sight (73.9%). The male and female were together on the nest only 3.1% of the time. Overall, the nest was unattended 30% of the nestling period.

The parents delivered yellow tussock grasses to the nest 20 times; the female brought most of the material ($n = 19$; 95%) at a rate of 0.11 deliveries per h. In contrast, prey was almost exclusively provided by the male ($n = 46$; 95.8%) at a provisioning rate of 0.25 prey deliveries per h. The female provided prey on only two occasions (4.2% of the total prey provided to the nest). Both events occurred when the nestling was 31-40 days old.

The nestling was fed almost exclusively by the female; the duration of feeding events ranged from 1 to 37 min (Table 1, mean = 12.1 min). Feeding involved only 5.3% of the time-activity budget in this period. After the nestling was >40 days old,

parents almost ceased feeding it (Table 1). At this age, the chick fed itself 4 times (2.3% of the time activity budget of this chick during this stage) at a rate of 0.12 feeding events per hour. Duration of these events averaged 12 min (range 1-25 min).

Discussion

For most of the behaviors studied here, the male and female Black-chested Buzzard-Eagles had clearly distinct roles during the different stages of the breeding cycle. This is consistent with the role of males and females in well-studied non-Neotropical Buteonine hawks and eagles from temperate areas that also feed on mammals and birds (Brown 1977, Newton 1979, Cramp & Simmons 1980, Olsen 1995). One important difference relative to other similar large-bodied raptor species observed in this study was the limited participation of the female in providing food to the nestling late in the nestling period; the male was the main and almost exclusive food provider during the whole nestling period. These findings do not fully support the prey-partitioning hypothesis, at least with regard to an increased involvement of the female in providing prey during the second half of the nestling period. Whether this represents a distinctive characteristic of this species or a trait of this particular pair is not known.

Pavez (2001) and Salvador *et al.* (2008) also observed limited involvement of female Black-chested Buzzard-Eagles in providing prey to the nestlings, but the provisioning rate and the exact stage of the nestling period when female provisioning happened was not reported in those studies. However, the results of those studies and ours may support the hypothesis that female Black-chested Buzzard-Eagles have limited involvement in providing prey to the nestlings. Alternative explanations may be related to the number of nestlings in broods (in this study only one for most of the time, thus reducing the demands), potential

Table 1. Time-activity budget of male and female *Geranoaetus melanoleucus* during the nestling period.

Activity	Days in nestling period			
	Days 1-10	Days 11-20	Days 31-40	Days 41-50
Observation time (min/h)	2,390/39.83	2,839/47.31	4,226/70.43	1,945/32.41
Feeding (events and rate)				
Male	0	0	2 (0.028/h)	1 (0.030/h)
Female	16 (0.401/h)	14 (0.295/h)	14 (0.199/h)	0
Total	16 (0.401/h)	14 (0.295/h)	16 (0.227/h)	1 (0.030/h)
Duration (mean and range)	9.5 (3-25)	15.63 (6-26)	11.69 (1-37)	NA
Nest material provisioning (events and rate)				
Male	0	0	1 (0.014/h)	0
Female	2 (0.050/h)	3 (0.063/h)	9 (0.127/h)	5 (0.154/h)
Total	2 (0.05/hr)	3 (0.063/hr)	10 (0.141/hr)	5 (0.154/hr)
Food provisioning (events and rate)				
Male	7 (0.175/h)	11 (0.232/h)	20 (0.283/h)	8 (0.246/h)
Female	0	0	2 (0.028/h)	0
Total	7 (0.175/h)	11 (0.232/h)	22 (0.312/h)	8 (0.246/h)
Male attending nest (%)				
Brooding	0.014	0	0	0
Feeding nestling	0	0	0.23	0.15
Total	12.55	9.58	12.49	7.66
Female attending the nest (%)				
Brooding	53.76	3.56	0	0
Feeding nestling	6.34	7.71	4.42	0
Total	86.23	79.40	49.26	34.09
Nestlings unattended (%)	4.44	14.97	40.87	59.69
Perching at nesting site (cliff, trees) (%)				
Male	11.38	11.73	17.96	18.20
Female	2.80	3.73	20.16	30.13
Out of sight (flying, displaying, hunting) (%)				
Male	76.06	78.69	69.55	74.14
Female	10.96	16.87	29.98	35.78

nest predators in the vicinity, or intra-pair variations in provisioning their nestlings, as individual differences in the division of labor between the sexes are known to occur among birds of prey (Newton 1979). In some species of raptors the female does not do any appreciable hunting until the young fledge; female participation seems to be dependent on the male's ability to provide food during this period, and, when food is abundantly provided by the male, the female is less obligated to leave the nest and hunt to provide food to the nestlings (Newton 1979). Both parental care and time-activity budgets of male and female raptors may vary as result of several biotic (*e.g.*, brood size, age of adults, food availability, competition with other predators) and abiotic (*e.g.*, day length, topography, weather) factors (Boulet *et al.* 2001, Palmer *et al.* 2001). Further studies examining a larger number of nests and investigating these factors are necessary to better understand parental care and time-activity budgets of Black-chested Buzzard-Eagles over its extensive distributional range.

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