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Forest-specialist raptors of the temperate forests of southern South America: a review

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Resumo**. Aves de rapina especialistas de florestas da região temperada do sul da América do Sul: uma revisão**. Nós revisamos a informação publicada sobre espécies de rapina presentes nas florestas temperadas do sul da América do Sul, focalizando nossos esforços nas quatro espécies especialistas de florestas, ou seja, as espécies dependentes da floresta especialmente para nidificação. Nós examinamos nove categorias de conhecimento ecológico: distribuição, habitat/seleção de habitat, movimentos, abundância, dieta, reprodução, comportamento, parasitas, e *status* de conservação. Nossos objetivos foram: 1) gerar uma base de dados sobre aves de rapina das florestas temperadas do sul; 2) detectar lacunas no conhecimento das aves de rapina; e 3) estabelecer prioridades de pesquisa sobre a ecologia dessas aves com base na quantidade de informação em referência às categorias detalhadas acima.

Palavras-chave. Aves de rapina, floresta temperada austral, Chile, Argentina, ecologia, revisão.

Abstract**.** We review the published information on the raptor species present in the temperate forests of southern South America, focusing our efforts in the four forest-specialist species, that is, forest-depending species especially for nesting. We examined nine categories of ecological knowledge: distribution, habitat/habitat selection, movements, abundance, diet, breeding, behavior, parasites, and conservation status. Our objectives are:1) generate a data base on raptors of the southern temperate forests; 2) detect gaps in the knowledge on raptors; and 3) establish research priorities on raptor ecology based on the amount of information referring to the above detailed categories.

Key words. Raptors, southern temperate forest, Chile, Argentina, ecology, review.

The temperate forests of southern South America stretch along the Andes continuously from approximately 35-55ºS in Chile and neighboring Andean sectors of Argentina at 36ºS meeting with the arid Patagonian steppes (Donoso 1993). These forests are isolated by > 1000 km from other South American forests (e.g., Andean Yunga forests of northwestern Argentina, lowland forests of southern Brazil) for at least 2-3 million year which makes this forest biome an island-like biota. This situation has accentuated the endemism level of temperate forest taxa and resulted in communities dominated by one or a few species per genera (Vuilleumier 1985, Armesto *et al*. 1996).

In spite of its fragility and scarce or null understanding of ecological dynamics, southern temperate forests have become reduced to less than one third of their original area (Lara *et al*. 1995, Smith-Ramírez 2004) being main causes the extensive burning to clear the land for agricultural use, replacement of native forests by pine plantations, and logging for the production of woodchips, firewood, sawn wood, and veneers (Lara *et al*. 1995). Actually, native forests in Chile are poorly represented in the National System of Protected Areas (SNASPE); only 10.3% of total protected areas are covered by native forests (Lara *et al*. 1995). In Argentina, exploitation of forest resources has recently started to increase, becoming a growing problem all over Patagonia (Schlichter and Laclau 1998). Even when most of forests are protected by the National System of Protected Areas (SNAP) (an estimated 33% of total forests area), some forest types or ecological zones are not enough protected and are exposed to some kind of degradation process of anthropic origin (mostly fires and extensive livestock, and most recently, pine plantations) (Schlichter and Laclau 1998).

The loss of old-growth, native forests is the most serious threat to the flora and fauna in the Patagonian temperate forest region (Fuentes 1994). The endemic forest-specialist fauna is the most critically threatened (Willson *et al.* 1994) among which various raptors are included (Jaksic and Jiménez 1986, Stotz *et al*. 1996). However, their secretive behavior, low population densities and habitat complexity make forest raptors very difficult to study and consequently most of them are poorly-known. Even so, information about raptors inhabiting the southern temperate forest has increased during the last decade. Here, we made a preliminary review on the natural history and ecology of forest-specialist raptors in the southern temperate forest ecorregion.

MATERIAL AND METHODS

We listed all raptors (Accipitridae, Falconidae, Tytonidae, and Strigidae) present in the southern temperate forest, and evaluated their degree of forest specialization by their capacity to hunt / nest in the forest interior and / or forest edges. We carried out a thorough literature search including published

papers, theses, unpublished manuscripts, books, and reviews. As almost all published literature on raptors before 1993 is included in del Hoyo *et al*. (1994, 1999), our review considered only the period from 1993 to the present.

RESULTS

There are 17 raptor species that can be seen in the forest interior and border. The analysis of these species resulted in the following operative classification (see Table 1): "specialist" (depending strictly on forest for nesting), "facultative" (habitat-generalists that may hunt and/or nest within the forest), "marginal" (generally open habitat species, but may hunt and/or nest in forest edges), and "occasional/accidental" (open habitat species, but occasionally/ accidentally may use forest edges to hunt). We found no "super-specialist" species, that is, that hunts and nests exclusively in the forest interior. Due to space considerations, we present only a review of the four forest-specialist raptors as resulted from our classification. However, we think that strict dependence to breed in the forest makes them the most sensitive to forest logging or forest fragmentation, which would pose a serious threat to the maintenance of a minimum viable population. For each species, we reviewed the following aspects: distribution, habitat, movements, abundance, diet, breeding, behavior, parasites, and conservation status.

Chilean Hawk (*Accipiter chilensis*)

Short reviews have previously been made by Brown and Amadon (1989), Bierregaard (1994), Figueroa *et al*. (2001a), Ferguson-Lees and Christie (2001), Pavez (2004) and Figueroa and Alvarado (in press 2006).

Distribution. Relatively well known. Although Aconcagua, Valparaíso region, was originally cited as the northern limit of the *A. chilensis* range in Chile (32º40' S; Philippi and Landbeck 1864, Hellmayr 1932), it is commonly mentioned from O'Higgins Province to Tierra del Fuego (34º-55º S; Bierregaard 1994, Ferguson-Lees and Christie 2001). Vuilleumier (1985) gave 33º-56º S as the latitudinal distribution of its breeding range. Occasional records have been made in Pichidangui (32º S, Pavez and González 1998, Pavez 2004) and Fray Jorge National Park (30º40' S, Tala and Mussa 1995), on the Pacific coast. A record in Oasis de Pica (20º S), but it could probably be *A. bicolor guttifer* (Martínez and González 2005). In Argentina, it is found from Neuquén (36ºS) to Tierra del Fuego (55ºS) following the Andes range (Fjeldså and Krabbe 1990, de la Peña and Rumboll 1998, Bellati 2000, Narosky and Babarskas 2000). A juvenile bird was occasionally observed

Table 1. Raptor species present in the southern temperate forest of Chile and Argentina, classified according their use of the forest. Terms defined in the text.

Species	Common name	Specialist	Facultative	Marginal	Accidental
Accipiter chilensis	Chilean Hawk	X			
Buteo albigula	White-throated Hawk	X			
Buteo ventralis	Rufous-tailed Hawk	X			
Strix rufipes	Rufous-legged Owl	X			
Glaucidium nanum	Austral Pygmy-owl		X		
Bubo magellanicus	Magellanic Horned Owl		X		
Tyto alba	Barn Owl		X		
Caracara plancus	Southern Crested-caracara		X		
Milvago chimango	Chimango Caracara		X		
Phalcoboenus albogularis[1]	White-throated Caracara		X?	X?	
Falco sparverius	American Kestrel			X	
Falco femoralis	Aplomado Falcon				X
Buteo polyosoma	Variable Hawk		X		
Parabuteo unicinctus	Harris's Hawk				X
Circus cinereus	Cinereous Harrier				X
Asio flammeus	Short-eared Owl				X
Geranoaetus melanoleucus	Black-chested Buzzard-eagle				X

[1] Insufficiently known.

by Olrog (1949) in Tafi del Valle at 26º50' S. Altitudinal distribution below 1000 m (Vuilleumier 1985, Fjeldså and Krabbe 1990), but it could reach up to 1500 m (Martínez and González 2005, S. Alvarado and A. Trejo, pers. obs.).

Habitat. Very little studied. *A. chilensis* inhabits mainly the temperate forests both in Chile and Argentina (Housse 1937, 1945, Goodall *et al.* 1951, Vuilleumier 1985). A fraction of the population also inhabits some sclerophyllous forest remnants in central Chile (Pavez 2004). It have been referred as a typical dweller of oak (*Nothofagus* spp.) and *Araucaria* forests (Housse 1945, Goodall *et al*. 1951, Johnson 1965, Fjeldså and Krabbe 1990, Bierregaard 1994, Martínez and González 2005). Vuilleumier (1985) described six habitat types used by *A. chilensis* in Patagonia: rainforest, mesophytic forest, montane forest, parkland, opening within forest, and forest/steppe ecotone. In Ñuble National Reserve, *A. chilensis* was observed in low elevation deciduous beech (*Nothofagus obliqua)* and mid-elevation highly stratified deciduous beech (*N. obliqua-N. pumilio*) forests, both types located in protected valleys (Estades 1997). *A. chilensis* may visits open habitats close to forests either agricultural fields with trees and shrubs, or shrub-steppe (Fjeldså and Krabbe 1990, Bierregaard 1994, Bellati 2000, Figueroa *et al*. 2004a,b), but it have rarely or never seen around highly human-modified areas (Jaksic *et al*. 2001). Some records in periurban areas (Bellati 2000), and parks and orchards within cities such as Punta Arenas (R. Matus, pers. comm. 1997), Coyhaique (S. Alvarado, pers. obs.), Temuco (C.A. Bravo pers. comm. 1997), and Santiago (Tomasevic 2004). We have regularly observed it in mixed deciduous *Nothofagus* forests and Valdivian rainforests, and occasionally in pine plantations mixed with native forest in Araucanía.

In Nevados de Chillán, it uses second-growth, mixed-deciduous *Nothofagus* forest patches as nesting habitats which are characterized by abundant older trees (height = 20–30 m, diameter = 1.1 m), close canopy (cover ranges = 50 to 85%), a midstory relatively dense and diverse, and many old, fallen trees (Figueroa et al. 2004b, Figueroa *et al*., 2007 in press). In Argentina, a nest was found in a pure even-aged *Nothofagus dombeyi* (tree height > 25 m) forest patch with a relatively open midstory composed mainly of southern bamboo (*Chusquea* spp., Ojeda *et al*. 2004). In the highly fragmented landscape of southern Chile, *A. chilensis* appears not to inhabit forest remnants less than 188 ha (Gantz and Rau 1999). Dietary studies demonstrates that *A. chilensis* makes a tridimensional use of the forest (Figueroa *et al.* 2004a,b; see below).

Movements. Not studied. It is believed contradictorily to be sedentary, nomadic or migratory (Bierregaard 1994, Rozzi *et al*. 1996b, Venegas and Sielfeld 1998, Couve and Vidal 2000, Ferguson-Lees and Christie 2001), but these assertions are not supported by evidence. Southern Patagonia populations believed to be seasonally migratory moving to temperate zones during winter (Venegas and Sielfeld 1998). Supposedly, a fraction of population of central Chile migrates toward northwestern Argentina, perhaps following northbound migratory passerines (Olrog 1949, Bierregaard 1994). Johnson (1965) speculated that hawks inhabiting *Nothofagus* forests moves toward north following migratory movements of *Columba araucana*. Jaksic *et al*. (2002) asserted that this hawk is a breeding migrant in Magallanes. Possibly, individuals that breed in Andean areas move to lowlands during winter (Ferguson-Lees and Christie 2001).

Abundance. Very little studied. Jaksic and Jiménez (1986) listed it as rare (< 5 individuals can be detected yearly), but it is said as relatively common in the Cape Horn (Venegas 1994). In Ñuble National Reserve, a mean density of 0.02 individuals/ha and 0.04 individuals/ha was estimated for *N. obliqua* and *N. obliqua*/*N. pumilio* forests, respectively (Estades 1997). In the highly fragmented forest of southern Chile, *A. chilensis* was only detected in one out of 18 forest remnants (Gantz and Rau 1999) giving a figure of 0.007 individuals/km^2. In Araucanía, only 0.01-0.02 individuals/km can be seen within forests (Figueroa *et al*. 2000). In Northwestern Argentine Patagonia, Bellati (2000) only observed 1 individual along 8291 km during road counts by vehicle in extra-Andean open habitats.

Diet. Very little studied. Some scarce references on *A. chilensis*' prey are in Housse (1945), Humphrey *et al*. (1970), Couve and Vidal (2000), Ojeda *et al*. (2004), and Pavez (2004). Sieving *et al*. (2000) reported attacks on rhinocryptids by *A. chilensis* in forest patches of Chiloé Island. A first quantitative analysis was made by Figueroa *et al*. (2004b) on the basis of 495 prey remains collected in Nevados de Chillán. These authors found that diet was constituted almost exclusively of birds (97.8% of all prey remains), with relatively few rodents (1.6%) and insects (0.6%). Curiously, no remains of *C. araucana* were found in the diet which was mentioned as the main prey of *A. chilensis* by Johnson (1965). Among avian prey, *T. falcklandii*, *Elaenia albiceps*, *Carduelis barbata*, *Xolmis pyrope*, and *A. spinicauda* were the most common. Based on literature and direct observations, Figueroa *et al.* (2004a) listed at least 37 taxa of vertebrates and two of insects as *A. chilensis*' prey. Among the vertebrate prey, the most of taxa were birds (n = 31), followed by rodents (n = 4) and reptiles (n = 2). Presence of rodents, reptiles and insects as prey remains contradicts a previous assertion that *A. chilensis* is strictly a bird-eating raptor (Housse 1945, Johnson 1965). Of the 36 identified vertebrate prey species 44.4% are endemic to southern temperate forest and 47.2% are widespread. Among endemic prey species, 46.7% (n = 14) are forest-specialists. Most of forest dwelling species are ground-specialists (26.7%) and microhabitat generalists (i.e., simultaneously utilizes ground, trunks, and canopy; 23.3%).

Breeding. Breeding cycle. Not studied. Housse (1945) asserted that pair formation initiates in October (mid austral spring) with incubation ranging 20-21 days. In the Nahuel Huapi National Park, Argentina, chick-rearing was observed during January (mid austral summer; Ojeda *et al*. 2004). In Nevados de Chillán, reproductive period occurs from late October to late February (late summer; S. Alvarado and R.A. Figueroa pers. obs.). Incubating females have been observed in December (early summer). Hatching may occur from late December

to early January. The chick-rearing period extends from January to February.

Nest. Little studied. Housse (1937) first described the A. chilensis' nest in Chile, but various details (clutch size, egg size, color of eggs, and nest description) suggest that it could be a Milvago chimango's nest (Thorstrom and Kiff 1999). Recently, Ojeda et al. (2004) described an authentic nest found in a Nothofagus dombeyi forest in southern Argentina, and Figueroa et al., (in press 2007) described five authentic nests in Nevados de Chillán. All authentic nests were built on forked branches in the upper part of the trees, 16-25 m above ground. Nests were built close to the main trunk or a vertical thick branch. The nesting trees were live adult Nothofagus dombeyi trees. The measured nests were oval-shaped platforms. In Nevados de Chillán, the main nest diameter and depth were 74.2 X 53.1 cm and 25.5 cm, respectively. In Argentina, the nest diameter and depth were 56 X 49 cm and 59 cm, respectively. Nests were built with dry twigs and sticks, which were strongly intertwined. In general, nest morphometrics was similar to that given for A. bicolor by Thorstrom and Quixchán (2000).

Eggs and productivity. Scarcely described. Although eggs of *A. chilensis* were described by Housse (1945), their authenticity is questioned by Thorstrom and Kiff (1999). Housse (1945) described eggs as elliptical, smooth but somewhat thick-shelled, white with large yellowish or greenish blotches concentrated around the larger pole and with numerous small and gray spots elsewhere. In contrast, 14 eggs of *Accipiter bicolor* (which form a superspecies with *A.chilensis*) collected by Thorstrom and Kiff (1999) were dull white, unspotted, no glossy and sub elliptical in shape; the inner surface of the shell had a light bluish or greenish tinge. In addition, freshly laid eggs may be light bluish grey (Wolfe 1964). Similarly, pieces of *A. chilensis*' eggshells found in Nevados de Chillán were light bluish white or dull white, unspotted and not glossy; the inner surface of some fragments was bluish tinged (Figueroa *et al*., 2007, in press). Pavez (2004) described eggs as entirely white, but gave not details. Housse (1937) asserted that clutch size range 4-6 eggs, but Thorstrom and Kiff (1999) only found clutches of 1-3 eggs from *A. bicolor*'s nests. In accordance with Thorstrom and Quixchán (2000), brood size of 2-3 chicks have been observed in Nahuel Huapi (Ojeda *et al*. 2004), central Chile (Pavez 2004), and Nevados de Chillán (S. Alvarado and R.A. Figueroa pers. obs.).

Behavior. Activity and general behavior. Not studied. It appears to perch mostly on branches during the day (S. Alvarado pers. obs.). It may be observed flying low between forest patches (Jaramillo *et al*. 2003). Although secretive, it may approach to human settlements (Housse 1945, Jaramillo *et al*. 2003). It defends breeding territory against other diurnal raptors (e.g., *B. polyosoma*; S. Alvarado pers. obs). An antipredatory display have been observed in chicks; when other raptors flies low above the nest, the chicks submerges its head in the body (S. Alvarado pers. obs.). Soar rarely (Jaramillo *et al*. 2003).

Vocalizations. Not studied. Referring to superspecies *A. bicolor*, Brown and Amadon (1989) described a soft clear whistle from a male near its just-fledged young, and a loud *cac cac cac* from a female near a nest; Fjeldså and Krabbe (1990) described a scolding *khow-khow-khow*…, or *woodpecker like kek-kek-kek*…, and Ferguson and Christie (2001) mentioned a squalling *waaah* for paired birds, and a high-pitched barking *keh keh ke*..., or *kow kow kow*…, and faster scolding *kek-kek-kek*…near to nest. Jaramillo *et al*. (2003) described a like-flicker sharp series of *kweek* notes. Similarly, Ojeda *et al*. (2004) mentioned a sporadic *kie-kie-kie* for an adult *A. chilensis* pair near a nest in Nahuel Huapi. In Nevados de Chillán, at least nine vocalizations have been recorded from a *A. chilensis* pair during the breeding season, including those mentioned above (S. Alvarado pers. obs.). During the non-breeding season, *A. chilensis* is silent (Ferguson and Christie 2001, Jaramillo *et al*. 2003, S. Alvarado pers. obs.).

Sociosexual behavior. Not studied. Apparently a territorial year-round monogamous hawk. It may be observed solitary (non-breeding period) or in pairs (breeding period; Ferguson-Lees and Christie 2001). It may soars during the breeding period (Ferguson-Lees and Christie 2001). Males would display an upward-downward eight-shaped flight during courtship (Pavez and González 1998). According to Brown and Amadon (1989) it could hunt in pairs.

Hunting behavior. Not studied. From Housse (1945) it is inferred that *A. chilensis* may search for prey by active searching and sit-and-wait tactics. Both of these have been observed in Nevados de Chillán (S. Alvarado and R. Figueroa pers. obs.). Also may capture flying insects (S. Alvarado pers. obs.)

Parasites. No published data. A species of louse was found in birds housed in museum collections: *Colpocephalum turbinatum* (D. González-Acuña pers. comm. 2005).

Conservation status. Not well defined. Listed as rare or inadequately known in Chile (Glade 1988, Rottmann and López-Calleja 1992, Ortiz *et al*. 1994, Jaksic *et al*. 2002, Estades 2004b). In Argentina, is considered not threatened (Dirección Nacional de Fauna Silvestre 1983, Úbeda and Grigera 1995). Globally, it is considered a rare species (Blake 1977, Bierregaard 1994, Ferguson-Lees and Christie 2001). Its population would be decreasing in Chile because of forest logging and human persecution (Jaksic and Jiménez 1986). Although referring to *A. bicolor*, Stotz *et al*. (1996) proposed that it merit a medium research priority, but not a high conservation priority. This hawk species is legally protected in Chile by the Hunting Law (Tala and Iriarte 2004). Included in Appendix II of the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

White-throated Hawk (*Buteo albigula*)

Short reviews have previously been made by Goodall *et al*. (1951), Johnson (1965), Bierregaard (1994), Ferguson-Lees and Christie (2001), and Pavez (2004).

Distribution. Present evidence indicates two areas of distri-

bution: the southern temperate forests of Argentina and Chile (at lower latitudes in the latter), and after an apparent gap, the tropical and sub-tropical Andes (from northwestern Argentina, through Bolivia, Perú, Ecuador and Colombia, to Venezuela). At present, the southernmost distribution known in Chile is Aysén (44˚05'S- 72˚17'W, Figueroa *et al*. 2002), and in Argentina, Los Glaciares National Park (50º02'S- 73º06'W, Imberti 2005).

Habitat. Preferred nesting habitat of *B. albigula* in the southern breeding grounds (Argentina and Chile) is the forest interior dominated by tall *Nothofagus* trees at 900 - 1600 m a.s.l. (Pavez *et al*. 2004, Trejo *et al*. 2004), although this hawk seems to be rather tolerant to humans and human habitation during breeding (Gelain *et al*. 2001). However, the hawks' hunting territory extends to the forest edges and to the grasslands above tree-line (Figueroa *et al*. 2001b, Trejo *et al*. 2006). According to all the consulted authors, in the rest of their distribution, *B. albigula* is found where montane forests meet high altitude grasslands at approximately 2000-3500 m. (e.g., Fjelså and Krabbe 1990, Thiollay 1996), although they have been observed at lower altitudes (1600 m in Los Toldos, Salta, northwest Argentina, I. Roesler pers. comm.2005). This same habitat (represented by the tall forest in contact with the high pastures), at a lower altitude, is used by the hawks for nesting in the southern temperate forest (Trejo *et al.* 2004).

Movements. In the 1970's, with the first observations of *B. albigula* in the Yungas region of the provinces of Tucumán and Salta (Höy 1969, Olrog 1972, 1979, 1985), the possibility of it being migratory was considered. Casas and Gelain (1995) reinforced it through their analyses of numerous observations of the species, in southern Argentina, concentrated only in spring and summer. Observations of migrating hawk groups in Central Chile, going south in spring and north in autumn, reaffirmed this possibility (Pavez 2000). Observations made over ten years in the Nahuel Huapi lake region, in northwestern Argentine Patagonia (e.g. see Gelain *et al*. 2001) indicate that the southern population is migratory, arriving in the southern temperate forests in September-October, and leaving at the beginning of April. These data coincide with the observations of Pavez (2000) in central Chile, and our own observations in southern Chile (A. Trejo, P. Capllonch and L. Sympson pers. obs.). Except for the migratory population that breeds in southern Argentina-Chile, all other sightings correspond to the tropical and subtropical Andes. According to all the consulted authors (Bolivia, Arribas *et al*.1995, Kempff Mercado 1985; Perú, Clements and Shany 2001, Walker 2002; Ecuador, Ridgely and Greenfield 2001; Venezuela, Phelps and Meyer de Schauensee 1978; Colombia, Hilty and Brown 1986, Salaman *et al*. 2001), *B. albigula*'s residency status in the rest of its distribution is unknown. Ridgley and Greenfield (2001) from Ecuador supported the hypothesis of the southern temperate forest being the only nesting area. However, (N. Krabbe pers. comm.2001) believes that Ecuador has resident populations since the hawks have been observed year round. He admits, nevertheless, that many of them may have been mistaken for other raptors of the area, given their resemblance with other species. To begin to clarify the migration routes of the southern Argentine breeding population, on 7 January 2005, the research team working in southern Argentina captured an adult male in an active nest in Bariloche (41º08'S, 71º12'W), and a satellite radio transmitter was attached to the bird using a Teflon harness, freeing it afterwards. The satellite locations showed that the hawk crossed the Andes approximately at that latitude, and began going northwards through Chile, to the Atacama desert (approximately 22ºS, 68ºW), where the signal was lost on 10 May 2005 (unpublished data). This coincides with previous sightings of this hawk in northern Chile (Johnson 1965).

Abundance. Little studied. *B. albigula* is listed as rare in all its distribution. However, it could be not so rare. At least in southern Argentina and Chile; the number of recorded sightings of the White-throated Hawk have increased significantly in the Andean-Patagonian region during the last two decades (Casas and Gelain, 1995; Pavez, 2000, Figueroa *et al*. 2001b). Gelain *et al*. (2001) found at least four breeding pairs in an area of 5300 ha.

Diet. Preliminary observations made in their breeding grounds both in Argentina and Chile indicated that *B. albigula* fed (and fed their nestlings) on small rodents and birds, and lizards (Figueroa *et al*. 2001b, Trejo *et al*. 2001, Pavez *et al*. 2004, Trejo *et al*. 2004). However in central Chile, along the hawks' migratory route, Pavez (2000) observed a high proportion of individuals (up to 70% migrating and stationary hawks) were observed hunting insects while in flight. Trejo *et al.* (2006) published the first quantitative data on food habits of *B. albigula* during the breeding season in Argentina by the combined analysis of pellets, prey remains and prey delivered to the nests. Results indicated that *B. albigula* fed on small mammals, birds, lizards and a high proportion of insects (up to 68% of total numbers of prey in pellets but underestimated by all the other methods). Hawks consumed occasionally some large-sized prey aside of small birds and rodents, such as European hares (*Lepus europaeus*), American Kestrels (*Falco sparverius*), Austral Parakeets (*Enicognathus ferrugineus*), and Magellanic Woodpeckers (*Campephilus magellanicus*), among others. We only have anecdotal observations on the hawks' diet in the subtropical and tropical Andes. In northeastern Argentina, hawks were observed pursuing Tinamiformes (P. Capllonch pers. comm. 2001).

Breeding. Breeding cycle. As far as we know, the only nesting records known for this species happen in the southern temperate forest of Argentina (Gelain *et a*l. 2001, Trejo *et al*. 2001, Trejo *et al.* 2004) and Chile (Pavez *et al*. 2004), between latitudes 33˚ and 41˚ S. One nest found in Coquimbo, Chile, supposed to be of *B. albigula*, but not confirmed by direct observation of the hawks (Johnson 1965). The only detailed description of the breeding cycles was published in Trejo *et al*. (2004) in northwestern Argentine Patagonia (Bariloche area): Breeding hawks arrive in the area about mid-September. The pre-laying period extends approximately until early

November. Copulations took place from mid-October to mid-November. Egg laying begins about 10-15 November, and incubation continued until 15-17 December (hatching of the eggs). Brood-rearing lasted for about 5-6 weeks. After fledging, post-fledging period when juveniles are seen in the company with one or two adults, and it is still fed by their parents. Adults and juveniles left the area at the end of April. Dates observed in central Chile (Pavez *et al*. 2004) coincided with those from Argentina.

Nest. Nests are stick platforms placed on forked branches in the mid-upper part of generally tall trees (16-25 m). Most described substrates are *Nothofagus* trees (Trejo *et al*. 2001, 2004), but in Chile one nest was placed on a peumo (*Cryptocarya alb,* Pavez *et al.* 2004). Diameter of the nests were approximately 70 X 60 cm (N = 7, Trejo *et al*. 2004). One nest in Chile was estimated in 1 m diameter (Pavez *et al*. 2004), but it was not actually measured but estimated from the ground. Besides, as hawks usually re-use some nest in successive breeding seasons, size of the nest is related to its age (Trejo *et al*. 2004).

Eggs and productivity. Clutch 1-2 eggs, in all cases only one fledgling (Pavez *et al.* 2004, Trejo *et al*. 2004), although in one nest two siblings were observed in the first week after hatching (Trejo *et al*. 2004). The only measured egg was 50.2 X 40.0 mm, white without gloss or spots on the outer side, and bluish inside (Trejo *et al*. 2004).

Behavior. Activity and general is a diurnal predator, beginning its activity when the sun is high (about 07:00 in summer) and going to rest before the sun goes down (about 19:00 in summer) (Trejo pers. obs.).

Vocalizations. Not studied. Rather vocal during the breeding cycle, claiming possession of territory, alarm, or interspecific communication. High-pitched repetitive kee-kee-kee-KEE-KEE, with an ascending note towards the end (Trejo pers. obs.)

Hunting behavior. Not well studied. It appears to utilize a wide range of hunting methods. Figueroa *et al*. (2001b) observed that hawks constantly rose from *Nothofagus* forest in the valleys and moved toward ridge slopes and ridge tops, where they employed various hunting methods (e.g. hovering, quartering). *B. albigula* was observed also pursuing ground prey within the forest, employing a sit-and-wait hunting method, using a branch situated at mid-height as a perch (Trejo pers. obs.).

Parasites. No published data.

Conservation status. Not well defined. Listed as rare or inadequately known in Chile (Glade 1988, Rottmann and López-Calleja 1992, Estades 2004b). Considered rare in Argentina (Dirección Nacional de Fauna Silvestre 1983, Olrog 1985, Chébez 1994) and in the rest of its distribution (Phelps and Meyer de Schauensee 1978, Kempff Mercado 1985, Hilty and Brown 1986, Arribas *et al*.1995, Clements and Shany 2001, Ridgely and Greenfield 2001, Salaman *et al*. 2001, Walker 2002). Úbeda and Grigera (1995) considered the species "not threatened" in Argentina. Globally not threatened (del Hoyo *et al*. 1994). Included in Appendix II of the CITES.

Rufous-tailed Hawk (*Buteo ventralis*)

Brief reviews have previously been made by Brown and Amadon (1989), W. S. Clark (1986), Bierregaard (1994), Figueroa *et al*. (2000), Pavez (2004), and Figueroa and Alvarado (in press) 2006c.

Distribution. Relatively well known. In Chile, *B. ventralis* is commonly believed to be distributed from Ñuble (Atacalco; Behn 1947) to Tierra del Fuego (36º-55º S; Brown and Amadon 1989, Blake 1977, Araya and Millie 1986, Jaramillo *et al*. 2003, Pavez 2004), but records have been made in Pichidangui (32ºS, Philippi-B. 1964), Maule Lagoon (35ºS, Howell and Webb 1995), Constitución (35º S, Estades 2004a), and Wollaston Archipelago (55º S, Couve and Vidal 2003). Rozzi *et al*. (1996a) observed this hawk in an uninhabited island of Chiloé Archipelago. In Argentina, its distribution range is not clearly determinate, existing few records with known locality (Navas and Manghi 1991, Gelain and Trejo 2001, Pastore 2003); it would extend along the Andes range from Neuquén to southwestern Santa Cruz provinces (Contreras *et al.* 1980, Chébez 1994, Couve and Vidal 2003, Veiga *et al*. 2005), and Tierra del Fuego at 54º50' S (Lago Yehuin and Lapataia, R. J.Clark 1986). Vuilleumier (1985) gave 35-56º S as its breeding range. Accidental records have been made in Lerma Valley, Salta, at 25ºS (G. Höy in Chébez 1994), and in Anconquija, Tucumán, at 27º S (Olrog 1949). However, the Olrog's record have been questioned by Ferguson-Lees and Christie (2001) suggesting a skin re-examination. Its altitudinal distribution would range 0-1000 m in elevation (Vuilleumier 1985). Ferguson-Lees and Christie (2001) claimed that this hawk' true distribution is masked by lack of ornithological studies of the region concerned, and confusions due to variations in color morphs.

Habitat. Very little studied. *B. ventralis* is considered a forest-specialist raptor (Blake 1977, Gelain and Trejo 2001), but occasionally visits open habitats (Bernath 1965, Venegas and Jory 1979, Humphrey *et al* 1970; authors pers. obs.) or pine plantations (Estades 2004a). Vuilleumier (1985) asserted that four habitat types are used by *B. ventralis* in Patagonia: mesophytic forest, parkland, openings within forest, and forest/steppe ecotone. However, there are records from the arid Patagonian steppe (Veiga *et al.* 2005). Stotz et al. (1996) mentioned that *B. ventralis* inhabits either southern temperate forests (including edges), arid low scrub, and arid montane scrub. Gelain and Trejo (2001) have observed *B. ventralis* in pure deciduous beech (*Nothofagus antarctica*) forests. Figueroa and Alvarado (pers. obs) observed resident individuals in Valdivian rainforest and mixed *Nothofagus-Araucaria* forests. Most of the records of *B. ventralis* have been made on mountain or rolling terrain covered with dense *Nothofagus* forest patches (Housse 1945, Gelain and Trejo 2001, authors pers. obs.). However, restriction to mountainous areas could be a result of the extirpation of forests on extended flat areas. Secondary and old-growth forests could be preferred by *B. ventralis* because they would provide older trees which are suitable for nesting, perching, mating and hunting (Housse 1945, Behn 1947,

Figueroa *et al*. 2001a, Gelain and Trejo 2001). Based on its diet, Figueroa *et al*. 2000 suggested that *B. ventralis* could be not an obligate forest hawk since equally consumed open-land and forest prey. Thus, *B. ventralis* appear to be an opportunistic raptor that hunts both in the forest and in open habitats or along habitat edges. It have never been seen around highly human-modified areas (Jaksic *et al.* 2001). More studies are necessary to determinate at which degree *B. ventralis* is a forest-specialist raptor.

Movements. Not studied. Believed to be sedentary or locally dispersive (Bierregaard 1994, Rozzi *et al*. 1996b, Ferguson-Lees and Christie 2001). However, records of G. Höy in Chébez (1994) and Olrog (1949) could correspond to migrant or wandering birds. Migrating flocks of hawks were observed flying northwards in April across Lonquimay Volcano in southern Chile (L. Sympson pers. obs. 2004).

Abundance. Very little studied. Jaksic and Jiménez (1986) listed it as rare (< 5 individuals can be detected yearly) throughout its distribution range. According to W. S. Clark (1986), it is one of the raptors most difficult to see in Patagonia. Stotz *et al.* (1996) indicated its abundance is unknown.

Diet. Very little studied. At least three species of mammals, eight of birds, one of snake, and two orders of insect have been documented as *B. ventralis*' prey (Housse 1945, Behn 1947, Greer and Bullock 1966, Markham 1970, Figueroa *et al*. 2000). European Hare (*Lepus europaeus*), Chilean Pigeon (*Columba araucana*), Southern Lapwing (*Vanellus chilensis*), Austral Thrush (*Turdus falklandii*), Chilean Tinamou (*Nothoprocta perdicaria*), and unidentified rodents are the most cited prey in literature. First quantitative analysis was made by Figueroa *et al*. (2000) on the basis of 14 pellets. These authors found that birds and mammals were the most important prey (55% and 38% of all identified item prey, respectively). Among birds, the most frequent species eaten were *Sturnella loyca* and *C. araucana*. All the mammalian prey were exotic species, with rodents being the most frequent. According Figueroa *et al*. (2000), *B. ventralis* would be a generalist predator preying on a diverse array of medium-sized vertebrates, with a pronounced proportion of birds in its diet.

Breeding. Breeding cycle. Not well studied. The breeding cycle of *B. ventralis* is unknown having only occasional data about nesting birds. According to Housse (1945), nest building, egg laying and incubation would be initiated in October (early austral spring) and hatching during November (middle austral spring). Chick rearing and fledgling period would occur during January (early austral summer) (Behn 1947, Figueroa *et al*. 2001a).

Nest. Little studied. *B. ventralis* appears to prefer large older trees to place its nests. All five nests documented were placed on live trees more than 25 m tall and more than 100 cm in diameter (Housse 1945, Behn 1947, Figueroa et al. 2001a). Platforms are placed on forked branches close to the main trunk or on a thick horizontal branch in the upper part of the trees (Housse 1945, Behn 1947, Figueroa et al. 2001a). In general, nest are round-shaped platforms built with large dry sticks strongly interwoven (Housse 1945, Behn 1947, Figueroa et al. 2001a).

Eggs and productivity. Eggs not described. Three juvenile birds were collected by Housse (1945) from a nest. However, Behn (1947) collected only a young from a nest. In Cerro Ñielol, only one fledgling was observed (R. Figueroa pers. obs.).

Behavior. Activity and general behavior.- Not studied. It has been recorded searching for prey, eating, soaring or roosting at different hours of the day (authors pers. obs.). Although this hawk may also perch on fence pole (Bernath 1965)**,** it would prefer to feed perched on large trees with dense foliage (Behn 1945, R. Figueroa pers. obs.). Apparently a timid bird (Couve and Vidal 2003), non-aggressive towards other buteos (Gelain and Trejo 2001).

Vocalizations. Little studied. A harsh prolonged *kee-ahrr* was described by Fjeldså and Krabbe (1990) and Jaramillo *et al*. (2003). Figueroa *et al*. (2001a) described breeding adult's voice as a long and shrill *quiiiiiiiiih… quiiiiiiiih.* Gelain and Trejo (2001) observed an adult bird issuing a shrill *eeeiiih* in southern Argentina.

Sociosexual behavior. Not studied. Apparently a territorial year-round monogamous hawk. It may be observed solitary or in pairs (Ferguson-Lees and Christie 2001). A single and coupled high circling display has been described (Ferguson-Lees and Christie 2001).

Hunting behavior. Not studied. Both active searching as sit-and-wait hunting methods seem to be used (authors pers. obs.).

Parasites. No published data. Presence of *Ascaris* spp. was reported by Behn (1947). Two species of lice have been found in birds housed in museum collections: *Colpocephalum turbinatum* and *Degeeriella fulva* (D. González-Acuña pers. comm. 2005).

Conservation status. Not well defined. Listed as rare, vulnerable or inadequately known in Chile and Argentina (Glade 1988, Rottmann and López-Calleja 1992, Ortiz *et al*. 1994, Chébez 1994, Úbeda and Grigera 1995, Fraga 1997, Jaksic *et al*. 2002). Globally, it is also considered a rare species (Blake 1977, Ferguson-Lees and Christie 2001). In spite of rarity, Jaksic and Jiménez (1986) suggested that populations appear to be increasing, perhaps benefited from forest-clearance which would increase prey availability. Fjeldså and Krabbe (1990) suggested that *B. ventralis* may not be at risk, but Bierregaard (1998) considers its conservation status as indeterminate. Although Stotz *et al*. (1996) listed it as vulnerable to human disturbance, they estimated that it do not merit an urgent conservation and high research priority. However, we believe *B. ventralis* could be threatened because the strong logging pressures on the remaining primary and secondary forests of southern Chile (Fuentes 1994, Armesto *et al*. 1996, Castro 2002) which affect mainly the older trees that this hawk uses for placing its nests, perching, mating, and hunting (Housse 1945, Goodall *et al*. 1951, Figueroa *et al*. 2000). Illegal hunting is also considered an important menace (Jaksic and Jiménez 1986); in farmlands, persecution of *B. ventralis* would be accentuated because juvenile birds may

be confused with juvenile Harris´ Hawks (*Parabuteo unicinctus*) which is believed to attack poultry (Jaksic and Jiménez 1986). This hawk species is legally protected in Chile by the Hunting Law (Tala and Iriarte 2004). Included in Appendix II of the CITES.

Rufous-legged Owl (*Strix rufipes*)

Some short reviews on the natural history of *S. rufipes* have been made by König *et al* (1999), Figueroa *et al.* (2000), Figueroa and Alvarado (in press) 2006c., and Jaksic *et al*. (2002). Recently, a more comprehensive review on the natural history, ecology and conservation of *S. rufipes* was made by Martínez (2005).

Distribution. Relatively well known. Because *S. chacoensis* was recognized as a separate species, the distribution range of *S. rufipes* is now restricted to central Chile and Patagonia (König *et al.* 1999). Its actual latitudinal distribution range would extend from Quillota (Valparaíso province) to Beagle Channel islands (33º-55º S; Vuilleumier 1985, Couve and Vidal 2000, Pavez 2004). However, its northern distribution limit is unclear. Based on the literature, Martínez (2005) indicated that *S. rufipes*' northern limit is Los Vilos (31º55' S). Presence of this owl in that locality is not actually confirmed. In Argentina, it is distributed from western Neuquén to southern Tierra del Fuego following the Andes range (37-55ºS; R. J.Clark 1986, de la Peña and Rumboll 1998, Couve and Vidal 2003, Veiga *et al*. 2005). Generally, from 0 to 1000 m in elevation (Vuilleumier 1985), but may reach up to 1500 m (authors pers. obs.).

Habitat. General habitat. Well known. *S. rufipes* inhabits sclerophyllous forests of central Chile and temperate rainforests in both southern Chile and Argentina (Díaz 1999, Stotz *et al.* 1996, Pavez 2004, Martínez 2005). In these forest types, *S. rufipes* may be found in diverse vegetation associations. Vuilleumier (1985) mentioned five habitat types used by *S. rufipes* in Patagonia: rainforest, mesophytic forest, parkland, openings within forest, and forest/steppe ecotone. This owl has rarely or never been seen around highly human-modified areas (Jaksic et al. 2001).

Habitat selection. Little studied. Habitat selection have only been studied by Martínez and Jaksic (1996) in Valdivian rainforests of southern Chile. Results indicated that *S. rufipes*' preferred habitats are second- and old-growth forests, but independently of the seral stage and tree species composition owls would select multi-stratified stands > 100 years old with canopy cover > 70%, dominant trees with d.b.h. (diameter to the breath height) > 28 cm, more than 5 snags/ha having at least 20 cm d.b.h. and signs of decay, such as woody abundant debris and emergent trees with broken limbs and/or a rotten core. This habitat structure would assure a high availability of tree holes for nesting, and a diversity of small-mammal prey. More studies are necessary to know if similar patterns influence *S. rufipes*' habitat selection in a widespread geographical range.

Movements. Little studied. Apparently, it is resident year-round (Martínez and Jaksic 1996, Rozzi *et al*. 1996b), but migratory movements have not been studied. According to König *et al.* (1999) young birds may wander outside breeding season. In Valdivian rainforests, the *S. rufipes*' home range would vary from 180 (continuous forest) to 1200 ha (fragmented forest) (Martínez 2005). In fragmented forests, owls appear to use forest patches moving among small and large patches (R.A. Figueroa pers. obs.).

Abundance. Little studied. *S. rufipes* is listed as rare (< 5 individuals can be detected yearly) in central Chile (27-36ºS), but common (1-5 individuals can be detected daily) in southern and southernmost Chile (36-56ºS). (Jaksic and Jiménez 1986). Recently, Martínez and Jaksic (1996) estimated 0.13 and 0.25 owl pairs/km for second-growth and old-growth stands in Valdivian rainforests. Because *S. rufipes* is an secretive owl, König *et al*. (1999) suggested it may be locally less rare than supposed. Stotz *et al*. (1996) classified it as uncommon to fairly common. Although common in temperate rainforests, *S. rufipes*' populations appear to be declining because of habitat loss (Jaksic and Jiménez 1986).

Diet. Relatively well studied. *S. rufipes* is a generalist feeder, but it preys mostly on insects and small mammals (Martínez 1993, Díaz 1999, Figueroa *et al*., 2006(b) in press, authors pers. obs.). At least 11 rodent, two marsupial, and a bat species are eaten by *S. rufipes* in the southern temperate forest (authors pers. obs.). The most eaten small mammal prey are long-tailed pygmy rice rats (*Oligoryzomys longicaudatus*), arboreal rats (*Irenomys tarsalis*) and colocolo opposums (*Dromiciops gliroides*) (Martínez 1993, Figueroa *et al*., 2006(b) in press). Camel crickets (*Cratomellus armatus*), cockroaches (*Blatta* spp.) and beetles are the most eaten insect prey (Martínez 1993). Passerine birds, lizards, frogs, crabs, scorpions, spiders, and snails are occasional prey (Martínez 1993, Ippi and Rozzi 2004, A. Trejo pers. obs.).

Seasonal diet. Little studied. In Valdivian rainforests, most insects and less small mammals are consumed during spring-summer (77-79% and 19-20% of all individual prey, respectively); but during autumn-winter consumption of small mammals increases (35-70%of all individual prey; Martínez 1993). Biomass contribution of small mammals may vary from 75% in summer to 97% in winter (Martínez 1993). Although insects may outnumber in the diet during spring-summer, its biomass contribution is unimportant on a year-round basis (<7%, Martínez 1993).

Prey selection. Little studied. Although the *S. rufipes* behaves as a generalist feeder taking a variety of prey available within the restrictions imposed by its hunting tactic (see below) and by prey size and behavior (Martínez 1993), selective predation on arboreal/scansorial small mammals has been demonstrated in Valdivian rainforests (Martínez and Jaksic 1997). *O. longicaudatus*, *I. tarsalis*, and *D. gliroides* were significantly more eaten than a number of cursorial small mammals in all sites studied by Martínez and Jaksic (1997). *O. longicaudatus* ac-

counted for more than 50% of all consumed individual prey, and 36-56% of total biomass. Selection on arboreal/scansorial prey appears also to occur in the Araucanian rainforest (Figueroa et al. 2006b).

Geographical variation in diet. Not studied, but a review from authors in preparation. S. rufipes' diet in the southern temperate forest seems to be conservative, being arboreal/scansorial small mammals the core of prey (Figueroa et al., 2006b). However, some differences exists among localities regarding the importance of the main prey species. In Valdivian rainforests, O. longicaudatus was the most eaten prey either in Andean and central localities (≥60% of all individual small mammal prey), but it accounted for a lesser proportion in a coastal locality (40%; Martínez and Jaksic 1997). On the contrary, D. gliroides constituted almost 15% on the coast, but < 2% in remaining localities. Conversely, Figueroa et al. 2006b) found that D. gliroides, I. tarsalis, and O. longicaudatus accounted for 43.5%, 26%, and 11% of all individual small mammal prey, respectively, in Araucanía. On the other hand, O. longicaudatus and I. tarsalis constituted 29% and 7% of all individual small mammal prey in a deciduous Nothofagus forest of Argentina; no D. gliroides were found (Udrizar et al. 2005). In contrast, S. rufipes prey more upon terrestrial than on arboreal/scansorial small mammals in sclerophyllous forests (Díaz 1999, authors pers. obs.). Geographical differences in the S. rufipes' diet have been attributed to habitat characteristics (Díaz 1999, Udrizar et al. 2005) and spatial distribution, abundance, size and behavior of small mammal prey (Figueroa et al. 2006b).

Breeding. Breeding cycle.Very little studied. Its breeding biology could be similar to that other *Strix* owls (Martínez 1995, König *et al*. 1999). Duration of the breeding period is unknown, but in southern Chile it would initiate in September (Housse 1945, Johnson 1967). Some enlightening information came from central Chile; nesting owls have been found in October in pine plantations mixed with native forest (Estades *et al*. 1998; M.A. Vukasovic pers. comm. 2005). Breeding period would extend from October to January with incubation and chick-rearing period lasting almost 30 and 34 days, respectively (M.A. Vukasovic pers. comm. 2005).

Nest. Not well studied. *S. rufipes*' nesting site was first described as a natural upward-facing cavity in the trunk of an older tree (Housse 1945, Johnson 1967). However, recently nests have been found on the ground (small depressions) or within an exposed cavity on snags (Estades *et al.* 1998, M.A. Vukasovic pers. comm. 2005). Nest material may consist of leaves, woody debris, and prey remains (Housse 1945, Estades *et al*. 1998). It apparently may utilize abandoned nests of other raptors (Housse 1945, Canevari *et al*. 1991)

Eggs. Well described. Typically lays 2-3 pure white eggs (Goodall *et al*. 1951, Estades *et al*. 1998, M.A. Vukasovic pers. comm., 2005), but a nest was found with only one egg (Estades *et al.* 1998). Egg measurements are 41.9-48.8 mm length and 31.5-40.1 mm width (N = 7; Goodall *et al*. 1951, M.A. Vukasovic pers. comm. 2005).

Behavior. Activity and general behavior. Not well studied. *S. rufipes* is mainly a nocturnal owl becoming active at dusk (Housse 1945, Goodall *et al*. 1951, Martínez 1995, 2005), but diurnal activity has eventually been recorded during the day (Ippi and Rozzi 2004). In Navarino Island, southernmost Chile, it was observed eating a passerine bird (*A. spinicauda*) at midday (Ippi and Rozzi 2004). During day, this owl roosts on branches in sites with dense foliage (Martínez 2005, Figueroa and Alvarado (in press) 2006c.).

Vocalizations. Well described. Vocalizations are issued only during night (Martínez 2005). A loud and hoarse di-syllabic *poorr*, *poorr* was described by de la Peña and Rumboll (1998). König et al. (1999) described the male's song as a guttural *kokoko-kwowkwowkwowkwowkwowkwowkwowkwow,* and that of female as a similar but slightly higher-pitched song. When excited, both sex may issue a loud guttural *kokoko-kwaihkwaikwkwowwkwowwkwowwkwowwkwow* (König *et al*. 1999). Martínez (2005) defined three vocalizations types each with specific functions: (1) localization call, which is utilized to delimit the territory and maintain the pair bond; it is described as *cóo-cóo-cóo-cóo-cóo-cóo-cóo-cóo-cóo-cóo* (it seem to correspond to the first song described by König *et al*. 1999), (2) contact scream call which is issued only by the females at the starting of the breeding season; it is described as *mííííííííooo…mííííííííooo…mííííííííooo…*, and (3) defiance or excited localization call which is issued by both sexes when defending their breeding territory against intruders; it is described as *cóo-cóo-cóo-cóo-juaá-juaá-juaá-juaá-cóo-cóo-cóo-cóo* (it seem to correspond to second song described by König *et al.* 1999).

Sociosexual behavior. Little studied. It is a territorial year-round monogamous owl, but solitary during non-breeding season (Martínez 1995, 2005).

Hunting behavior. Little studied. It is described as a sit-and-wait predator hunting on prey that venture on branches or climb on trees, or move from one spot to another leaping in the ground (Martínez and Jaksic 1997, Martínez 2005). No description of other hunting methods.

Parasites. No published data. A louse species (*Strigiphyllus syrnii*) has been found on owl specimens maintained in collections of museum (D. González-Acuña pers. comm.2005).

Conservation status. Not well defined. It is listed as inadequately known (Glade 1988, Estades 2001) or vulnerable (Rottman and López-Calleja 1992) in Chile. In Argentina, the species is considered not threatened (Dirección Nacional de Fauna Silvestre 1983, Úbeda and Grigera 1995). Although Stotz *et al*. (1996) listed it as vulnerable to human disturbance, they estimated that it do not merit an urgent conservation and high research priority. However, *S. rufipes*' populations appear to be declining throughout the region, a likely cause being decreasing habitat availability brought about by logging (Jaksic and Jiménez 1986, Jaksic *et al*. 2001). Pesticides may also be a likely cause (König *et al*. 1999). We believe that the population viability of *S. rufipes* is uncertain, and it could became a critically threatened species (Omland *et al*. 2001). This owl

species is legally protected in Chile by the Hunting Law (Tala and Iriarte 2004). Included in Appendix II of the CITES.

DISCUSSION

A high-dependence on forests to nest and, to a lesser degree, to hunt, activities of main importance for survival of birds in general, and raptors in particular (Janes 1985, Wiens 1989), make forest-specialist raptors especially vulnerable to alterations of their habitat. In consequence, a thorough knowledge on their requirements is vital not only for their conservation but also for all the other raptors that use the forest at a lesser extent.

Of the four species considered in this review, three are endemic to the southern temperate forests: *Strix rufipes*, *Accipiter chilensis*, and *Buteo ventralis*. The fourth, *Buteo albigula*, has a wide distribution along the mist-forests of Andean South America. However, the southern forest are its only known breeding areas at the present. Even if this species breeds in the rest of its range, these areas are of unquestionable importance for the species. The populations here seem to be healthy and are possibly much more abundant than previously thought, while in the tropical Andes are thought to be very rare. In this particular case, more research studies are required in the tropical Andes.

As to the biology of the species, we have some knowledge on *B. albigula* and *S. rufipes*, but we know practically nothing of *A. chilensis* and *B. ventralis*. As we showed, most information on *A. chilensis* is speculative and contradictory. Basic aspects, many of them fundamental to develop any management strategy and/or conservation plans both for raptors and forests, are lacking for all raptors: for example, population dynamics, community structure, even abundance (present and historical).

Even when research on forest raptors has notably increased in the last years, both in Chile and Argentina, samples are in general small, and replication of studies are lacking to allow us drawing conclusions or generalizations on the species. The only replicate study is on breeding biology made in Argentina and Chile (Pavez *et al*. 2004, Trejo *et al*. 2004).

The development of studies on both sides of the Andes is similar although somewhat unequal when individual species are considered. However, similar habitats and species although somewhat different situations of management and conservation in Chile and Argentina, require integrated research efforts. It is necessary to reinforce already existing bonds among research groups and a fluid communication to advance in the knowledge on these threatened species and their habitats.

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