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THE CONSERVATION STATUS OF RAPTORS IN THE METROPOLITAN REGION, CHILE

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ABSTRACT.—The Mediterranean ecosystem in the Metropolitan Region of Chile is among the most threatened in the country because of human impacts caused by the concentration of 5.5 million people in an area of only 15 800 km^2. We analyze species presence at three spatial scales: the entire region, Santiago city and its surroundings, and two suburban localities where there has been intensive monitoring of raptors in the recent past. Twenty-four raptor species (18 Falconiformes and 6 Strigiformes) were found in the Metropolitan Region (83% of Chile's total). Twenty-one of them are resident species that breed and winter in the area. Overall, four species have increased over the last 30 years, seven have decreased, and 11 remained at the same levels. There is insufficient information available to determine the status of two species. Of the 24 species in the region, 18 occur in the vicinity of Santiago, the largest city in the country. We classified seven species (29% of the regional total) as either urban (four species) or suburban raptors (three species), and we discuss how they apparently cope and even thrive in such a large urban area.

KEY WORDS: *Falconiformes; Strigiformes; habitat; diet; residence; conservation; abundance; urban raptors.*

El estatus de conservación de las rapaces en la Region Metropolitana de Chile

RESUMEN.—El ecosistema mediterrañeo en la Región Metropolitana de Chile es uno de los mas amenazados del país debido al impacto humano causado por la concentración de 5.5 millones de personas en un área de 15 800 km. Analizamos la presencia de especies en tres escalas espaciales: La región entera, la ciudad de Santiago y sus alrededores, y dos localidades suburbanas en donde ha habido monitoreo intensivo de rapaces en el pasado. Veinticuatro especies de rapaces (18 falconiformes y 6 strigiformes) fueron encontradas en la Región Metropolitana (83% del total de Chile). Veintiún de estas son especies residentes que anidan y permanecen en el área durante el invierno. En general cuatro especies han aumentado durante los últimos 30 años, siete han disminuido y 11 permanencen en el mismo nivel. Hay información insuficiente para determinar el estatus de dos especies. De las 24 especies en la región, 18 ocurren en la vecindad de Santiago, la ciudad mas grande en el país. Hemos clasificado siete especies (29% del total regional) como urbanas (cuatro especies) o suburbanas (tres especies) y discutimos cómo estas aparentemente pueden sobrevivir en esta área urbana tan grande.

[Traducción de César Márquez]

Mediterranean ecosystems of the world are among the most threatened (Rundel et al. 1998). These relatively-small, mid-latitude areas are found at about 30°N and S latitude on the western margins of North America, Europe, Africa, Australia, and South America. The climate, with its cool and mildly-rainy winters with warm and dry summers especially near the coast, are highly conducive to orchards and vineyards and it attracts people by the millions. California is a well-known case, but the Metropolitan Region of Chile is no exception, concentrating about 5.5 million people in an area of only 15 800 km^2. How do raptors cope with extraordinary densities of people?

Jaksic and Jiménez (1986) and Jaksic (1997) reported 28 raptor species in Chile. Subsequently, Araya et al. (1998) added *Cathartes burrovianus, Buteo magnirostris,* and *Herpetotheres cachinnans* to the falconiforms and *Glaucidium nanum* to the strigiforms. Although we concur with the addition of the latter species, we do not think that the three falconiforms should actually be included in the list since they occur very rarely in northernmost Chile. Our estimate of the raptor community diversity at 29 species agrees exactly with that of del Hoyo et al. (1994, 1999), whose nomenclature we follow. It should be noted that the recent AOU checklist (1998) considers the Cathartidae as a family within Ciconiformes, and not in the Falconiformes. For comparison to our previous work (Jaksic and Jiménez 1986), we consider vultures as carrion-eating raptors.

Herein, we analyze species richness at three spatial scales ranging from the entire region, to Santiago city, and finally to small peripheral localities, with the aim of providing a sketch of the current status of the raptor community.

STUDY AREA

Central Chile, roughly spanning from Copiapó to Concepción (27°–37°S), is flanked by the Coastal Ranges to the west (maximum elevation = 2281 m) and the Andean Ranges to the east (maximum elevation = 5424 m). The Central Valley is a rather flat expanse (mean elevation = 500 m) cut by numerous small rivers and ridges. The region naturally belongs to the Mediterranean biome and is much like that which is found in central and southern California. The climate is semiarid with a summer drought. Winters are cool and slightly rainy and summers are warm and dry. The original vegetation was an evergreen scrub, which is now found only on inaccessible slopes. The original vegetation was first cleared for agriculture but, as the population grew, prime agricultural lands have been absorbed by encroaching urban development (Elizalde 1970, Hajek et al. 1990, Gross and Hajek 1997). Even the Andean slopes have recently been developed and the wetlands associated with the major rivers in the area have been largely drained and filled.

The Metropolitan Region (15 800 km^2) has been occupied by people since the colonial times of the mid-16th century. Only 6% of the flatlands still has native vegetation and most of the area consists of plantations, orchards, vineyards, cultivated land, pastures, mountains (which contain native vegetation), and urban centers. The city of Santiago is located in the middle of the Central Valley at about 33°S latitude. It is at 600 m elevation and has an average annual rainfall of 360 mm. The city itself has about 4.5 million inhabitants, but peripheral towns, including Puente Alto, San Bernardo, and Maipú add another million people to the population. The urban area has grown very rapidly and the population has increased by two million people over the last 20 years. Currently, 95% of the population is urban and only 5% is rural. Over 45% of the entire Chilean population lives in the capital city and surroundings.

METHODS

This paper is based on our collective field data collected over the past 24 years. We also reviewed the relevant literature for distributions and habitat descriptions of raptors throughout Chile (Johnson 1965, 1967, Jaksic 1997), for their status in central Chile (Housse 1945, Schlatter 1979), and for their conservation status in the whole country (Jaksic and Jiménez 1986). In some instances, our own field data contradicted the literature sources that we consulted.

We recognized five major habitat types used by raptors: (1) mountains, including air space, tall hills, and ridges; (2) wetlands, including river beds and marshes; (3) agricultural areas, including pastures, cultivated lands, plantations, and orchards; (4) urban areas, including parks, squares, treed avenues, cemeteries, and buildings; and (5) dumps, including fish markets, slaughter houses, and garbage dumps.

We placed resident raptors into three categories: (1) all-year residents, which breed and overwinter in the Metropolitan Region; (2) migrants, which apparently do not breed in the region but usually are seen in particular seasons; (3) occasional visitors, which do not breed in the region and are only detected sporadically, with no seasonal pattern.

We used the key to abundance first devised for Chilean raptors by Jaksic and Jiménez (1986): abundant = >5 individuals detected (seen or heard) daily; common = 1–5 individuals detected daily; frequent = 1 individual detected weekly; scarce = 1 individual detected monthly, rare = <5 individuals detected yearly. This made our current assessments comparable to our earlier work.

RESULTS AND DISCUSSION

Based on our results, a total of 24 species of raptors occur in the Metropolitan Region of Chile (83% of the national total). Twenty-one of them are residents that, for the most part breed and winter in the area, although a fraction migrate in and out (Zalles and Bildstein 2000). Partial migrants include the Red-backed Hawk (*Buteo polyosoma,* Jiménez 1995), Cinereous Harrier (*Circus cinereus*), White-tailed Kite (*Elanus leucurus*), Chilean Accipiter (*Accipiter chilensis,* Pavez and González 1999), Peregrine Falcon (*Falco peregrinus*), and Short-eared Owl (*Asio flammeus*). Two other species are confirmed migrants that visit the region during different seasons, and another is an occasional visitor (Table 1).

Of the 24 species in the Metropolitan Region (Table 1), six (25%) including the Osprey (*Pandion haliaetus,* Schlatter and Morales 1980, Aguirre and Seeger 1995), Chilean Accipiter, White-throated Hawk (*Buteo albigula*), Long-winged Harrier

Table 1. Raptors in the Metropolitan Region, Chile and their status.

SPECIES	RESIDENCE	ABUNDANCE	POPULATION	KEY FACTORS
Cathartidae				
Cathartes aura	All-year resident	Frequent	Stationary	Unknown
Coragyps atratus	All-year resident	Frequent	Stationary	Unknown
Vultur gryphus	All-year resident	Common	Decreasing	< Habitat, < Food, Shooting
Accipitridae				
Pandion haliaetus	Summer migrant	Rare	Stationary	Unknown
Accipiter chilensis	All-year resident	Rare	Decreasing	< Habitat, Shooting
Buteo albigula	Spring-Fall migrant	Rare	Decreasing	< Habitat
Buteo polyosoma	All-year resident	Common	Stationary	< Habitat, Shooting
Circus buffoni	Occasional visitor	Rare	Unknown	< Habitat
Circus cinereus	All-year resident	Scarce	Decreasing	< Habitat
Elanus leucurus	All-year resident	Common	Stationary	< Habitat, > Food
Geranoaetus melanoleucus	All-year resident	Common	Stationary	< Habitat, > Food, Shooting
Parabuteo unicinctus	All-year resident	Common	Stationary	Shooting
Falconidae				
Falco femoralis	All-year resident	Scarce	Stationary	< Habitat, Shooting
Falco peregrinus	All-year resident	Frequent	Stationary	Shooting
Falco sparverius	All-year resident	Common	Increasing	> Habitat, > Food
Milvago chimango	All-year resident	Abundant	Increasing	> Habitat, > Food
Phalcoboenus megalopterus	All-year resident	Frequent	Stationary	Unknown
Polyborus plancus	All-year resident	Rare	Unknown	Unknown
Tytonidae				
Tyto alba	All-year resident	Common	Increasing	> Habitat, > Food
Strigidae				
Asio flammeus	All-year resident	Scarce	Decreasing	< Habitat
Athene cunicularia	All-year resident	Frequent	Decreasing	< Habitat
Bubo magellanicus	All-year resident	Common	Stationary	Unknown
Glaucidium nanum	All-year resident	Common	Increasing	> Habitat, > Food
Strix rufipes	All-year resident	Rare	Decreasing	< Habitat
Number of species	24			

Abundance in the Metropolitan Region: abundant = >5 individuals detected (seen or heard) daily; common = 1–5 individuals detected daily; frequent = 1 individual detected weekly; scarce = 1 individual detected monthly; rare = <5 individuals detected yearly.

(*Circus buffoni*), Crested Caracara (*Polyborus plancus*), and Rufous-legged Owl (*Strix rufipes*, Díaz 1999), have rarely or never been seen around the city of Santiago. The remaining 18 species make up the pool of naturally-occurring species that may tolerate urban encroachment, or even be able to invade new habitats afforded by parks, squares, cemeteries, and buildings.

Of this pool of 18 species in the periphery of Santiago, 11 (46% of the regional total) are found chiefly or only in the city surroundings (Table 2). The Andean Condor (*Vultur gryphus*) and the Andean Caracara (*Phalcoboenus megalopterus*) may occur occasionally, chiefly in the foothills of the Andes, to the east of Santiago. They depend on livestock carcasses, but also visit garbage dumps in ski resorts and mining camps (Pavez 2000a, Pavez and Tala 1995). The Andean Condor traverses the Central Valley during winter, when it is seen along the Coastal Range. Turkey (*Cathartes aura*) and Black Vultures (*Coragyps atratus*) are seen chiefly toward the west of Santiago, but they occasionally drift further inland toward the foothills of the Andes or to Santiago itself. The latter species is more gregarious and soars higher than the former. These two vultures appear to tolerate human activities and actually seem to do well, but are never abundant, in garbage dumps and close to slaughterhouses and fish markets. The Cinereous Harrier and Short-eared Owl, both ground-nesters in wetlands, seem very sensitive to human and livestock disturbance, and may be dwindling in abundance and distribution as wetlands are used as pastures or drained and developed. Red-backed Hawks and

Table 2. Raptors in Santiago city and surroundings, Chile.

SPECIES	RESIDENCE	ABUNDANCE	WHERE SEEN	WHERE NESTING
Cathartidae				
Cathartes aura	Occasional	Scarce	Mountains, dumps, agriculture	Cliffs
Coragyps atratus	Occasional	Scarce	Mountains, dumps, agriculture	Cliffs
Vultur gryphus	Occasional	Scarce	Mountains, agriculture	Cliffs
Accipitridae				
Buteo polyosoma	Resident	Frequent	Mountains	Trees, cliffs
Circus cinereus	Occasional	Rare	Wetlands	Ground
Elanus leucurus	Resident	Frequent	Agriculture	Trees
Geranoaetus melanoleucus	Resident	Scarce	Mountains	Cliffs, trees
Parabuteo unicinctus	Resident	Scarce	Mountains, park, wetlands, agriculture	Trees
Falconidae				
Falco femoralis	Occasional	Rare	Mountains, agriculture	Cliffs
Falco peregrinus	Occasional	Rare	Mountains, buildings	Cliffs, buildings?
Falco sparverius	Resident	Common	Agriculture, parks, buildings, mountains	Cliffs, trees, buildings
Milvago chimango	Resident	Abundant	Agriculture, parks, dumps	Trees
Phalcoboenus megalopterus	Occasional	Rare	Mountains	Cliffs
Tytonidae				
Tyto alba	Resident	Common	Agriculture, parks, buildings, mountains	Buildings, cliffs, trees
Strigidae				
Asio flammeus	Occasional	Rare	Wetlands, agriculture	Ground
Athene cunicularia	Resident	Frequent	Agriculture	Ground
Bubo magellanicus	Occasional	Scarce	Agriculture, parks, mountains	Trees, cliffs
Glaucidium nanum	Resident	Common	Parks, agriculture	Trees, buildings
Number of species	18			

Abundance in Santiago city and surroundings: Abundant = >5 individuals detected (seen or heard) daily; common = 1–5 individuals detected daily; frequent = 1 individual detected weekly; scarce = 1 individual detected monthly; rare = <5 individuals detected yearly.

the Black-chested Buzzard Eagles (*Geranoaetus melanoleucus*) are associated with native shrub vegetation and their populations appear to decline as shrublands are cleared and replaced by exotic plantations or urban development. The ultimate cause of their decline may be the disappearance of prey associated with native vegetation (Schlatter et al. 1980b, Jiménez and Jaksic 1989a, 1990, 1991, Jiménez 1995, but see Pavez et al. 1992). The Aplomado Falcon (*Falco femoralis*), Peregrine Falcon, and Magellan Horned Owl (*Bubo magellanicus*) occur mostly to the east and west of Santiago, close to the Andean mountains or Coastal Ranges. Nevertheless, Peregrine Falcons and Magellan Horned Owls occasionally occur inside the city, the former perching on tall buildings and the latter on trees in parks.

Seven species (29% of the regional total) may be classified to some degree as urban or suburban raptors. Two are hawks, two are falcons, and three are owls. Among the diurnal raptors, the Chimango Caracara (*Milvago chimango*) is the most widespread and abundant in the city. It appears to tolerate people well (Cabezas and Schlatter 1987) and actually seems to thrive in garbage dumps and close to slaughterhouses and fish markets. The Harris' Hawk (*Parabuteo unicinctus*) is tolerant of human disturbance, occupying areas with trees in the city's suburban areas, where it hunts for naturalized birds and introduced mice (Yáñez and Jaksic 1978, Jaksic et al. 1980, Jiménez and Jaksic 1993a). Nevertheless, it does not seem to benefit from its association with the human environment in the city's suburbia, and is perhaps slowly losing to development. To the contrary, the White-tailed Kite seems to gain some advantage from its association with agricultural landscapes (Meserve 1977), where human commensal, such as intro-

Table 3. Raptors in the suburban localities of Lo Curro/La Dehesa (Schlatter 1979) and in San Carlos de Apoquindo (this work), Chile.

SPECIES	LO CURRO/LA DEHESA	SAN CARLOS DE APOQUINDO	ABUNDANCE
Cathartidae			
Coragyps atratus	Occasional visitor	Occasional visitor	Rare
Vultur gryphus	Winter visitor	Regular visitor	Common
Accipitridae			
Accipiter chilensis	Not present	Occasional visitor	Rare
Buteo albigula	Not present	Spring-Fall migrant	Scarce
Buteo polyosoma	All-year resident	All-year resident	Common
Circus cinereus	Likely resident	Occasional visitor	Rare
Elanus leucurus	All-year resident	Occasional visitor	Scarce
Geranoaetus melanoleucus	All-year resident	All-year resident	Common
Parabuteo unicinctus	All-year resident	All-year resident	Common
Falconidae			
Falco femoralis	Likely resident	Occasional visitor	Rare
Falco peregrinus	Occasional visitor	All-year resident	Frequent
Falco sparverius	All-year resident	All-year resident	Common
Milvago chimango	All-year resident	All-year resident	Abundant
Phalcoboenus megalopterus	Not present	Regular visitor	Frequent
Tytonidae			
Tyto alba	All-year resident	All-year resident	Frequent
Strigidae			
Asio flammeus	Not present	Occasional visitor	Rare
Athene cunicularia	All-year resident	All-year resident	Scarce
Bubo magellanicus	All-year resident	All-year resident	Frequent
Glaucidium nanum	All-year resident	All-year resident	Common
Number of species	15	19	

Abundance in San Carlos de Apoquindo: abundant = >5 individuals detected (seen or heard) daily; common = 1–5 individuals detected daily; frequent = 1 individual detected weekly; scarce = 1 individual detected monthly; rare = <5 individuals detected yearly.

duced mice (*Mus musculus*) have become a more important part of its diet (Schlatter et al. 1980a, Mendelsohn and Jaksic 1989). Unfortunately, as the rodents are poisoned and the city engulfs suburban areas for housing development, ultimately this kite will decline. Among the falcons, the American Kestrel (*Falco sparverius*) is only second to the Chimango Caracara as the most abundant diurnal raptor in the city. In the urban environment, the kestrel preys extensively on insects, naturalized birds such as House Sparrows (*Passer domesticus*), and also on introduced mice.

Among the nocturnal raptors, the Barn Owl (*Tyto alba*) appears to be the most tolerant of humans and it uses buildings, particularly church bell towers, to nest and roost. It may benefit from the substantial commensal population of introduced mice found in the city but not rats (*Rattus* spp.), which are too large for this owl (see Jaksic and Yáñez 1979, 1980). The Burrowing Owl (*Athene cunicularia*) is tolerant of the suburban environment as it is elsewhere (Schlatter et al. 1980c, 1982, Lincer and Steenhof 1997), but seems to be threatened by the rapid conversion of agricultural lands to high-density housing development where it can't live. The Pygmy Owl (*Glaucidium nanum*) is an elusive raptor, but it occurs even in small treed gardens in the city (Solar 1975). They are difficult to see, but easy to hear during the breeding season (Jiménez and Jaksic 1989b). They seem to take advantage of the ample supply of native birds that take shelter in urban trees (Jiménez and Jaksic 1993b, Estades 1995).

Only two studies have been conducted on suburban raptors for over a year in Chile (Table 3). Schlatter's (1979) pioneer study demonstrated that in the area of Lo Curro/La Dehesa, there was a total of 15 raptor species from February 1973–

April 1974, 12 of which were residents. We made observations of raptors in San Carlos de Apoquindo, about 4 km south of the area studied by Schlatter (1979). Observations were made monthly between 1980–1999. We detected a total of 19 species, 10 of which were residents. Because Lo Curro/La Dehesa was completely engulfed by the city in the late 1970s, most of its raptors have disappeared. San Carlos de Apoquindo is representative of many piedmont areas to the east of Santiago city, which have been and are being affected by urban expansion. There is an important altitudinal gradient from 1050–1915 m elevation. The area has several degrees of human impact, from recently-urbanized areas in the lower elevations toward Santiago city, to high mountainous areas with scarce human disturbance. For this reason, the most important impacts on the local raptor assemblage have been in the lower confines. In 1981, the Short-eared Owl disappeared from the lower area as an all-year resident, where it lived in pastures that were replaced by housing developments. Similarly, the Burrowing Owl and White-tailed Kite decreased due to habitat reduction and urban encroachment. The White-tailed Kite disappeared from the lower area as an all-year resident around 1985, and since then it is scarce at higher elevations. The Burrowing Owl still persists as a year-round resident, but at higher elevations than before and in smaller numbers. In contrast, the American Kestrel and especially the Chimango Caracara have become more abundant in the low-lying and altered areas.

At mid-altitudes, ravines and gentle slopes that support secondary schlerophyllous scrub have large populations of Magellan Horned Owls, Pygmy Owls, Barn Owls, and Harris' Hawks in places with dense vegetation cover and Black-chested Buzzard Eagles and American Kestrels in more open areas. Areas with low scrub and large cliffs situated to the east of the site where elevations are ≤1800 are good habitats for Peregrine Falcons and Red-backed Hawks, and are also regular wintering sites for Andean Condors and Andean Caracaras.

The Black Vulture, Chilean Accipiter, Cinereous Harrier, White-tailed Kite, Aplomado Falcon, and Short-eared Owl, are only occasionally seen in San Carlos de Apoquindo, and may be migrants (see Zalles and Bildstein 2000). Although Red-backed Hawks, Chilean Eagles, and Peregrine Falcons live in the area, their populations swell with migrants during winter (Zalles and Bildstein 2000). Another migrant, the White-throated Hawk, is seen here only a few days during its migratory movements in spring and autumn (Pavez 2000b).

Only three or four species (13% or 17% of the regional total) may be considered to be true urban raptors that apparently thrive in the middle of Santiago city, wherever adequate shelter and food resources are available. The Chimango Caracara, American Kestrel, and Pygmy Owl are small in size, show a tolerance of human activities, and have omnivorous diets (Yáñez and Núñez 1980, Núñez et al. 1982, Yáñez et al. 1980, 1982, Jiménez and Jaksic 1989b, 1993b). They differ in that the Chimango Caracara is gregarious, whereas the American Kestrel and Pygmy Owl are territorial. The Barn Owl may be added to this group, but its large size, broad hunting range, and more extensive territory inhibits it from becoming as common as the other three species. We know very little on how these raptors cope with the urban environment. Studies dealing directly with the ecology of these urban raptors are needed if we are to understand how these raptors deal with humans and the environment they generate (Bird et al. 1996).

CONCLUSIONS

Based on our assessment, of the 24 species of raptors that occur in the Metropolitan Region, four have been increasing over the last 30 years, seven have been decreasing, 11 have remained unchanged, and for two there are no data to make an assessment of the current status. All of the species that are decreasing are doing so because of habitat deterioration brought about by human activities including the clearing of native vegetation for agricultural and urban development. The four species that are increasing have been benefitted by the same processes that affect the remaining species. They are thriving in the new habitats created by humans, apparently because of increases in commensal species, such as introduced mice and naturalized birds, that serve as new prey.

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