



A MIGRATORY BOTTLENECK FOR THE WHITE-THROATED HAWK *BUTEO ALBIGULA* IN THE ANDEAN FOOTHILLS OF CENTRAL CHILE

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Abstract · The White-throated Hawk *Buteo albigula* is one of the most abundant migratory raptors in the Austral-Neotropical system, but no bottlenecks in its migratory routes are known. Here, we describe the finding of the first migratory bottleneck for this species on the Andean slopes of central Chile. We counted a total of 5,424 White-throated Hawks migrating from south to north from 17 March until 13 April 2023, in Cachapoal, O'Higgins Region, Chile (34° S; 70° W). In addition, we counted 1,314 Variable Hawks *Geranoaetus polyosoma* and seven Cinereous Harriers *Circus cinereus* migrating through this site for a total of 6,745 raptors, which represent the largest count of migrant raptors in the Austral-Neotropical system. Both, the passage rate (24.2 hawks/hour) and the total number of White-throated Hawks observed per season, were higher at Cachapoal than at any other previous count site (daily passage rate range = 1.0–7.2 hawks/hour; total hawks per season = 35–294). We estimated that over 84% of the breeding population of White-throated Hawks transit the Cachapoal bottleneck during their autumn migration. Remote tracking technologies and observations at other points of the Andes should help to further examine this proposal. Continuing with the long-term count of White-throated Hawks in this bottleneck will allow us to assess the population trends of this important predator in the southern temperate forests.

Resumen · Un cuello de botella migratorio para el aguilucho chico *Buteo albigula* en las estribaciones andinas de Chile central

El aguilucho chico *Buteo albigula* es una de las rapaces migratorias más abundantes en el sistema Austral-Neotropical, pero no se conocen cuellos de botella en sus rutas migratorias. Aquí describimos el hallazgo del primer cuello de botella para la especie en el piedemonte Andino de Chile central. Observamos un total de 5.424 aguiluchos chicos migrando de sur a norte entre el 17 de marzo y el 13 de abril de 2023 en Cachapoal, Región de O'Higgins (34°S; 70°O). Adicionalmente, contamos 1.314 aguiluchos variables *Geranoaetus polyosoma* y siete gavilanes cenicientos *Circus cinereus* migrando por este sitio, totalizando 6.745 rapaces, lo que representa el mayor conteo de rapaces en el sistema Austral-Neotropical. Tanto la tasa de paso (24,2 aguiluchos/hora) como el total de aguiluchos chicos observados por temporada migratoria fueron más altos en Cachapoal que en cualquier otro sitio de conteo previo (rango de tasa de paso diario = 1,0–7,2 aguiluchos/hora; total de aguiluchos chicos por temporada = 35–294). Estimamos que más del 84% de la población reproductiva del aguilucho chico usa el cuello de botella de Cachapoal durante la migración otoñal. Deben realizarse más estudios usando tecnología de seguimiento remoto y observaciones en otros puntos de los Andes para poner a prueba esta sugerencia. Continuar con el conteo a largo plazo de aguiluchos chicos en este cuello de botella permitirá evaluar las tendencias poblacionales de este importante depredador de los bosques templados australes.

Key words: *Accipitridae* · Andean corridor · Austral Temperate Forests · Conservation · Migration counting

INTRODUCTION

Atmospheric and landscape features, including waterways and mountain ranges, funnel migratory raptors into predictable bottlenecks, through which thousands of individuals may pass in a short time (Bildstein 2006). These bottlenecks are the best sites for long-term counting, monitoring population trends, and migration timing in a cost-effective way (Bildstein et al. 2009, Wehrmann et al. 2019). Furthermore, since human alterations in such small concentration areas could have population level effects (Thake 1980, Runge et al. 2014), identifying migratory bottlenecks is a key priority for the conservation of migratory raptors.

The White-throated Hawk *Buteo albigula* is an obligate migratory forest raptor that each year makes a long journey between the austral temperate forests of central and southern Chile and southwestern Argentina, where it breeds, and the tropical and subtropical Andean montane forests of Bolivia, Peru, Ecuador, Colombia, and Venezuela, where it overwinters (Trejo et al. 2006, Rivas-Fuenzalida et al. 2023). As such, it is one of the most notable migrant raptors of the Austral-Neotropical system (Bildstein 2004). It migrates singly or more often in small flocks (Pavez 2000); however, groups of more than 100 individuals have been reported (Pavez 2007).

To date, two main migratory corridors (Figure 1) are known for the species: 1) the western Andean flyway from central Chile bordering the Atacama Desert and rising to the inter-Andean valleys of southern Peru (Pavez 2000, Bechard et al. 2010, Rivas-

Submitted 11 May 2023 · First decision 14 May 2023 · Acceptance 08 Dec 2023 · Online publication 25 Jan 2024

Communicated by Carlos Bosque

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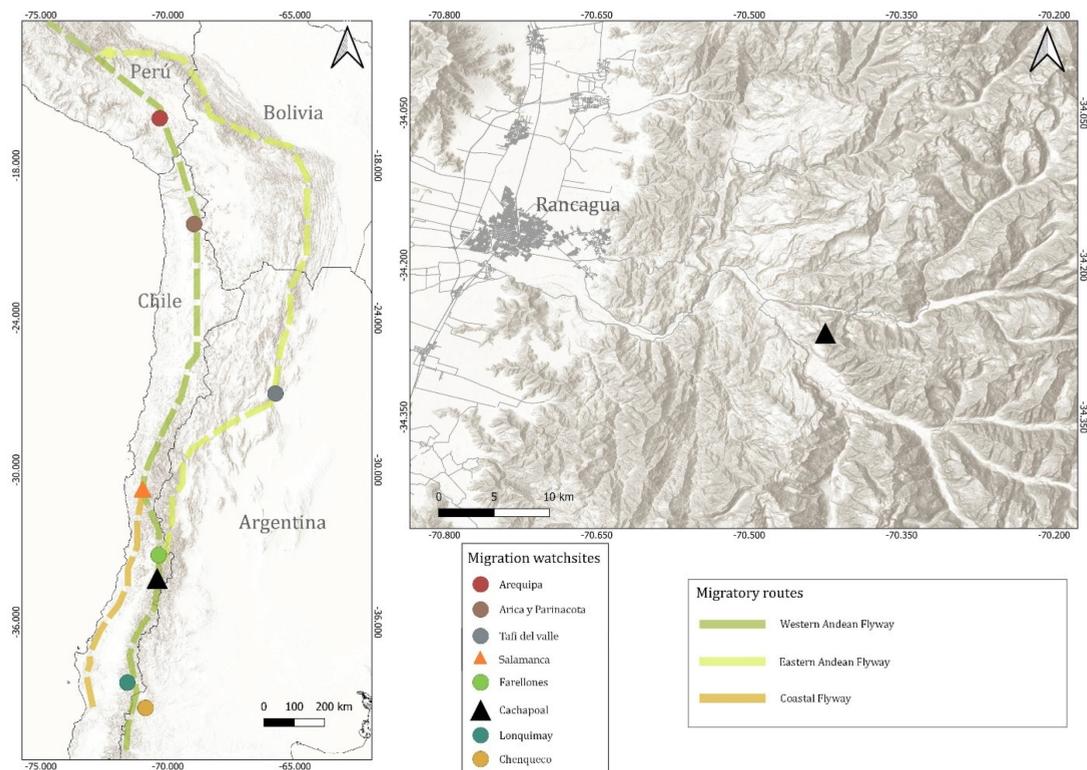


Figure 1. Migratory routes of White-throated Hawks *Buteo albifluga* identified to date in their southern range (see text). Left. Location of several watch sites used to count White-throated hawks in this study and previous studies. Right. Location of the Cachapoal Watch site migratory bottleneck in central Chile, described in this work.

Fuenzalida et al. 2017, 2023, Vásquez y Allasi 2017, Medel et al. 2018, Rivas-Fuenzalida & Quispe-Flores 2021), and 2) the eastern Andean flyway through the Yungas of Argentina, Bolivia, and southern Peru (Trejo et al. 2007, Rivas-Fuenzalida et al. 2017, 2023). North of these areas, White-throated Hawks continue to migrate along a wide front through the Andes of Peru, Ecuador, and Colombia (Bechard et al. 2010, Rivas-Fuenzalida et al. 2017, 2023), while south, some individuals travel across the Coastal Mountain Range of central and southern Chile, and others use both slopes of the Andes (Trejo et al. 2007, Rivas-Fuenzalida et al. 2017, Juhant & Seipke 2010). However, Andean migration between 37°S and 32°S has been observed only in the western slopes of the Andes, where migrants from southern Argentina and Chile converge (Trejo et al. 2007, Juhant & Seipke 2010, Rivas-Fuenzalida et al. 2023). Up to now, no bottlenecks are known for the species (Bildstein 2004, Rivas-Fuenzalida et al. 2023). The general objective of our study was to identify the location of a bottleneck that potentially concentrates large number of migratory White-throated Hawks to establish a monitoring station in order to examine their long-term population trends.

METHODS

Study sites and sampling method. During the 2022 and 2023 austral autumn migration seasons (March–April), we conducted migration counts at three fixed watch sites in the Andean foothills of central Chile to evaluate the best site for counting White-throated Hawks (Figure 1). All areas were in the sclerophyllous forest ecoregion of central Chile, with vegetation dominated by Andean sclerophyllous scrubs. In the mountain foothills of the southernmost watch site, the vegetation also includes sclerophyllous forests.

Salamanca watch site, Coquimbo region (31°51'S,

70°49'W; 720 m a.s.l.). This site was located in a foothill in Quelen near Salamanca. We selected this point because a coastal migrant White-throated Hawk tracked by satellite used the hill to roost during its autumn migration in 2018, which suggested that both coastal and Andean migrants joined to fly northward in this area (Rivas-Fuenzalida et al. 2017).

We spent two days (March 26–27, 2022; 13 sampling hours) recording the passage of White-throated Hawks at the Salamanca site. Local inhabitants prevented us from approaching the hill to observe the hawk’s passage more closely because of their security issues (drug trade). Our observation point was located at 720 m a.s.l., and the hawks passed approximately 2.5 km east of the observers while flying over a hillside at approximately 1,500 m a.s.l. The beginning of the observation period varied from 11:00 to 14:00 h, ended at 19:00 h, and included two observers (TRF and EZ).

Farellones watch site, Metropolitan region (33°21'S, 70°19'W; 2,250 m a.s.l.). This site was located 15 km east of Santiago city and 173 km south of the Salamanca site. We selected this site because it was previously used for monitoring the migration of White-throated Hawks between 1996–1998 (Pavez 2000).

We spent three days (March 29–31, 2022; 21 sampling hours) at the Farellones site. Our observation point was located at 2,250 m a.s.l., and the hawks passed from eye level to observers or 50–100 m above the observers. The beginning of the observation period varied from 9:00 to 15:30 h, ended at 19:00 h, and included two observers (TRF and EZ).

Cachapoal watch site, O’Higgins region (34°17'S, 70°26'W; 1,080 m a.s.l.). This site is located in the foothills of the Mantales Range, north of the Cachapoal river, 14 km east of Coya Town, and 104 km south of the Farellones watch site. We selected this site because a migratory flock of 120 White-

throated Hawks was reported in March 2007 (Pavez 2007).

During the 2022 austral autumn migration season, we spent five days (April 01–05; 33 sampling hours) recording the passage of White-throated Hawks in the Cachapoal site. We observed from a point located at 1,080 m a.s.l., and the hawks passed at ca. 1.9 km north-east of the observers flying over a hillside at 2,200 m a.s.l. The start of the observation period varied from 10:00 to 14:00 h and ended at 19:00 h. During the 2023 season, we spent 30 days (March 15–April 13; 240 sampling hours) observing for migration, eight hours per day (11:00 to 19:00 h) at the Cachapoal site. We chose the starting observation hour at 11:00 h because no hawks were observed earlier during the autumn 2022 sampling periods and because wind speed increased after that time at this site. Because the first observation of a White-throated Hawk occurred on 17 March, we used that date as the starting point to calculate the sampling effort (28 days; 224 sampling hours) and the daily passage of hawks. We made simultaneous observations from two fixed points located at the foot of the Manantiales Range (Figure 2), from where we were able to count hawks passing above two mountain tops: Agujereado Hill (2,522 m a.s.l.) and Guayacán Hill (2,860 m a.s.l.). One of the points was the same as the one used in 2022, and the other was 800 m east to the latter at 1,130 m a.s.l.

Two skilled observers recorded the passage of birds during each survey: TRF and EZ during the 2022 surveys; TRF and SC during the 2023 surveys (March 15–April 06); and TRF and KBA at the end of the 2023 surveys (April 07–13). All observations were made using 10x50 binoculars, and a 20–60x100 spotting scope. All observers were highly experienced at identifying White-throated Hawks (i. e., >17-year experience with the species). We used standardized daily reports and spreadsheet templates adapted from the Hawk Migration Association of North America (Bildstein et al. 2009) to record the data. Although we were able to identify three age classes: adults (Figure 3), immature, and juvenile (Rivas-Fuenzalida & Martínez-Piña 2020), the high altitude of most hawks flying over Agujereado prevented us from obtaining age data in this study. To

avoid double counting, we only recorded birds gliding in a single direction from south to north along rocky walls or hills (e.g., Bildstein 2006). As sometimes the same individuals passed by the two mountaintops (Agujereado and Guayacán), and observers informed each other by radio to avoid double counting. To characterize flocking behavior, we distinguished six grouping classes: 1) alone flight, 2) small flocks (2–10 individuals), 3) medium-sized flocks (11–20 individuals), 4) large flocks (21–50 individuals), 5) very large flocks (51–100 individuals), and 6) massive flocks (101–210 individuals).

We also counted migratory Variable Hawks *Geranoaetus polyosoma* and Cinereous Harriers *Circus cinereus* in 2023 that used these same migration sites. We did not count these species in the 2022 season. Resident raptor species in the area included Variable Hawk, Black-chested Buzzard-Eagle *Geranoaetus melanoleucus*, Harris's Hawk *Parabuteo unicinctus*, Chilean Hawk *Accipiter chilensis*, Peregrine Falcon *Falco peregrinus*, American Kestrel *Falco sparverius*, Mountain Caracara *Daptrius megalopterus*, Chimango Caracara *Daptrius chimango*, Andean Condor *Vultur gryphus*, and Turkey Vulture *Cathartes aura*.

Although we did not record wind conditions, the areas maintained stable weather conditions throughout the counting period, with most of the days (90%) sunny and winds (30–40 km/h; according to the Windy app.) from the west.

RESULTS

During the 2022 autumn migration (March 25–April 05; 10 days; 67 hours), we counted 1,179 White-throated Hawks at the three watch sites. During the autumn migration of 2023 (March 17–April 13; 28 days; 224 hours), we counted 6,745 raptors of three species migrating through the Cachapoal watch site. The most abundant species was the White-throated Hawk (80.4%), followed by the Variable Hawk (19.5%) and the Cinereous Harrier (0.1%).

Salamanca watch site. We observed only six White-throated Hawks migrating from south to north singly during two

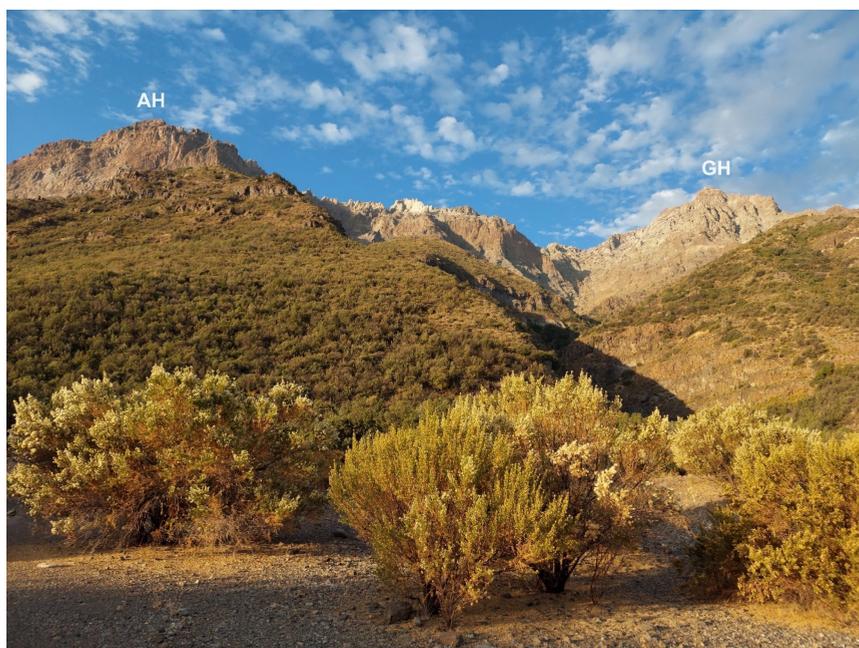


Figure 2. View of Agujereado Hill (AH left), and Guayacán Hill (GH right) were thousands of migrating White-throated Hawks *Buteo albigula*, and other raptors were counted during the 2023 autumn season. Cachapoal Watch site, O'Higgins region, central Chile. Photo: Tomás Rivas-Fuenzalida.



Figure 3. Adult White-throated Hawk *Buteo albigula* in migratory flight at Agujereado Hill, Cachapoal watch site, O'Higgins region, central Chile. Photo: Tomás Rivas-Fuenzalida.

consecutive days. Hawks passed through the hill slope from 13:21 h to 18:51 h. One of these individuals was observed hunting (probably catching insects in flight), and then it continued flying north. The passage rate was 0.5 hawks/h, and the average daily passage was three hawks/day (range = 2–4).

Farellones watch site. We observed 152 White-throated Hawks migrating through the Farellones area during three consecutive days. Most hawks came from the southwest and soared to gain altitude east of Farellones, then flew to the northeast. Hawks migrated past the site between 10:28 and 14:50 h. Four hawks flew singly, 11 flew in small flocks (range = 2–4; N = 4 flocks), and 137 were observed in very large flocks (range = 63–74; N = 2 flocks). The passage rate was 7.2 hawks/h, and the average daily passage was 50.7 hawks/day (range = 4–137). One of the very large flocks (63 hawks) headed straight east ca. 7 km before reaching Farellones without crossing the Molina River, disappearing behind the eastern mountains. Another 77 White-throated Hawks were observed following the same direction on 25 March 2023 (Jorge Toledo, pers. com.). These distant flocks were visible only by using a spotting scope.

Cachapoal watch site 2022. We observed 1,021 White-throated Hawks in the Cachapoal area, passing through the

hilltop of Cerro Agujereado over five consecutive days. The migrant White-throated Hawks arrived from the south and southeast, heading toward the Agujereado Hill, and soaring in circles to gain altitude before gliding to the north. Hawks passed by the watchsite from 11:00 to 18:25 h. Twelve hawks flew singly, 195 hawks flew in small flocks (N = 35 flocks; range = 2–10 hawks), 171 hawks flew in medium-sized flocks (N = 11 flocks; range = 11–20 hawks), 324 hawks flew in large flocks (N = 13 flocks; range = 21–30 hawks), and 319 hawks flew in very large flocks (N = 6 flocks; range = 34–85 hawks). The passage rate was 30.9 hawks/h and the average daily passage was 204.2 hawks/day (range = 12–324). For 270 White-throated Hawks at Agujereado Hill that we were able to observe closely, 74.1% were adults, 22.2% were juveniles, and 3.7% were immatures.

Cachapoal watch site 2023. We counted 5,424 White-throated Hawks during 28 consecutive days. Hawks passed through the site from 11:51 to 18:52 h, concentrating their flight during the mid-day and afternoon, with most of the hawks passing between 15:00 to 16:00 h (Figure 4). Most hawks (96% of the total) flew in flocks. Two hundred and nineteen hawks flew alone (4% of the total), 1,375 flew in small flocks (25% of the total, N = 326 flocks; range = 2–10 hawks),

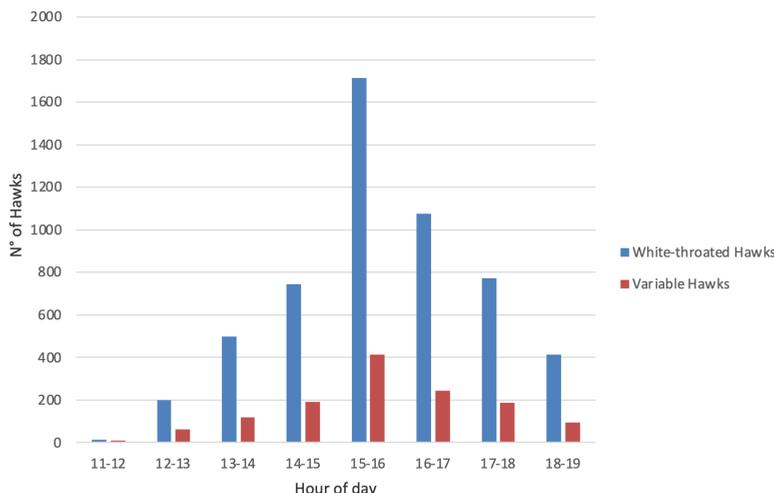


Figure 4. Number of migrant White-throated Hawks *Buteo albigula*, in blue and Variable hawks *Geranoaetus polyosoma*, in red per time of the day, between March 17–April 13 2023, in Cachapoal watchsite, central Chile.

743 in medium-sized flocks (14% of the total, $N = 50$ flocks; range = 11–20 individuals), 1,467 flew in large flocks (27% of the total, $N = 41$ flocks; range = 21–50 hawks), 606 in very large flocks (11% of the total, $N = 9$ flocks; range = 53–92 hawks), and 1,014 in massive flocks (19% of the total, $N = 7$ flocks; range = 108–210 hawks). We detected four peak days during the migration (Figure 5): 21 March (669 hawks), 25 March (735 hawks), 30 March (717 hawks), and 4 April (540 hawks). The massive flocks were recorded on the same dates of peak days: 21 March (157 hawks), 25 March (150 and 110 hawks), 30 March (150, 124, and 108 hawks), and 4 April (210 hawks). The passage rate was 24.4 hawks/h, and the average daily passage was 193.7 hawks/day (range = 1–735 hawks/day). White-throated Hawks seemed to increase in numbers during windy days, but often the days after a peak resulted in low counts, independent of the wind conditions.

Other migrant species. We counted two other raptors migrating at the Cachapoal watch site in 2023, Variable Hawks ($N = 1,314$), and at Cinereous Harriers ($N = 7$). Variable Hawks migrated alone (32% of the total, $N = 425$), in small groups of 2–10 individuals (45% of the total, $N = 593$), or in medium-sized groups of 11–26 individuals (23% of the total, $N = 296$). Variable Hawks often flew mixed with White-throated Hawk

flocks. Cinereous Harriers migrated alone ($N = 5$) or in pairs ($N = 2$) and never mixed with flocks of other species. The passage rate for Variable Hawks was 5.9 hawks/h, and the average daily passage was 46.9 hawks/day (range = 6–193). We observed three peak days during the Variable Hawk's migration (Figure 5): 4 April (193 individuals), 7 April (121 individuals), and 13 April (122 individuals). The diurnal pattern of Variable Hawk migration was similar to that of the White-throated Hawk, with most of Variable Hawks passing between 15:00–16:00 h (Figure 4). Cinereous Harriers passed very sparsely throughout the counting period (during six often non-consecutive days between March 22–April 09).

DISCUSSION

We showed that the largest number of fall migrant White-throated Hawks travel through Cachapoal in the western Andean slopes of the O'Higgins Region in central Chile, which represents the largest known bottleneck for migratory raptors in the Austral-Neotropical system, through which two other species of migratory raptors pass.

The Cachapoal watch site in the Austral-Neotropical system. Our count of 6,745 raptors (in 28 days/224 sampling

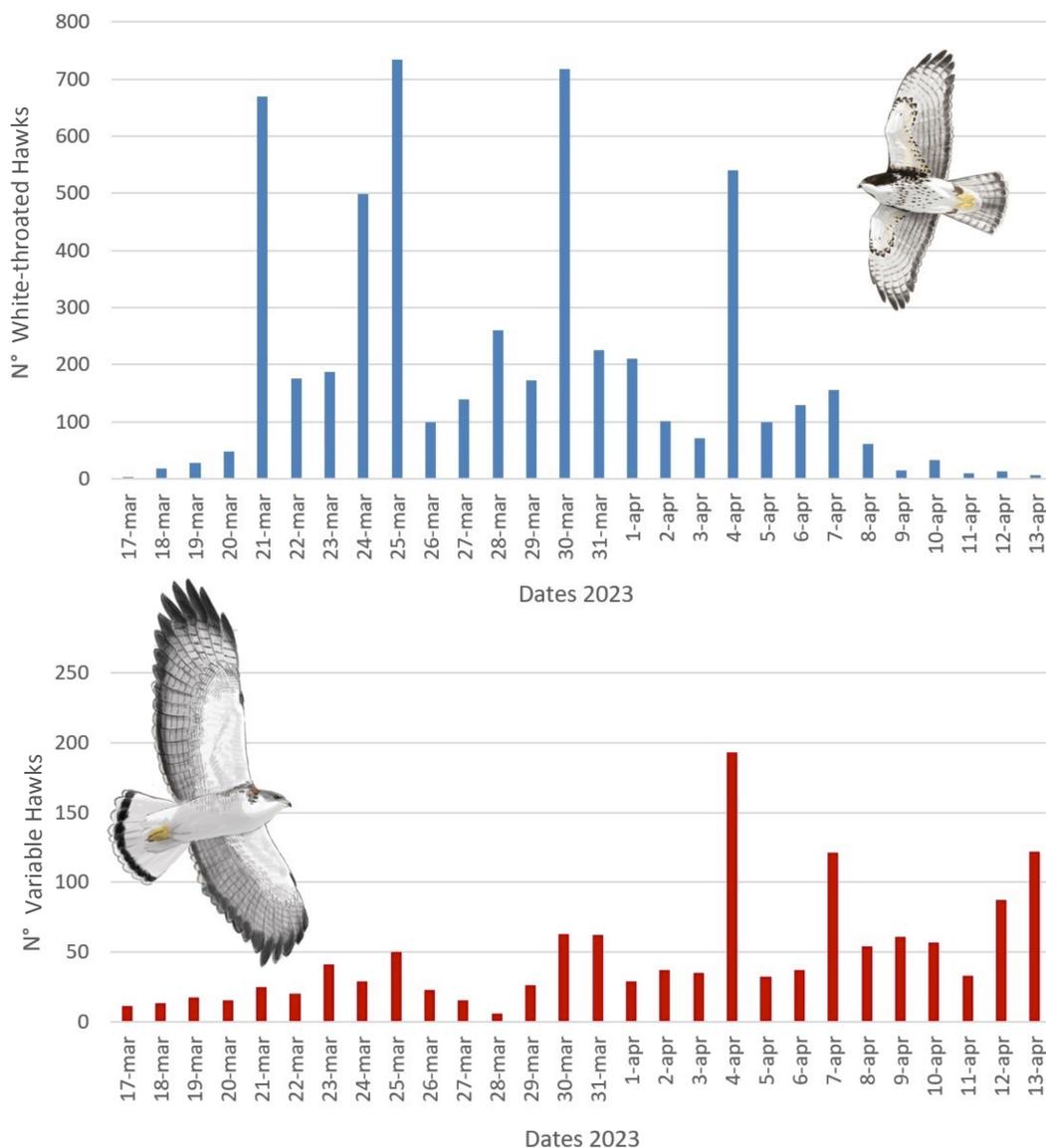


Figure 4. Number of migrant White-throated Hawks *Buteo albigula* (top) and Variable Hawks *Geranoaetus polyosoma* (bottom) per day between March 17–April 13 2023, in the Cachapoal watch site, central Chile.

hours) represents the largest number of migrant raptors counted at any autumn watch site in the Austral-Neotropical system (Pavez 2000, Olivo 2003, Juhant 2010, Juhant & Seipke 2010, Medel et al. 2018), and reveals that the Cachapoal site is the most important bottleneck known to date for White-throated Hawks, since both, the passage rates, average daily passage, and total number of hawks were significantly higher in Cachapoal than in previous watch sites monitored in Argentina and Chile (Pavez 2000, Trejo et al. 2007, Juhant & Seipke 2010, Medel et al. 2018; Table 1). The same is true for the Variable Hawk (Juhant & Seipke 2010, Medel et al. 2018).

Migratory routes of the White-throated Hawk and the Cachapoal bottleneck. Based on the available evidence, we hypothesize that almost all White-throated Hawk populations that breed in the Andes of Chile and Argentina follow the western Andes corridor of central Chile during their fall migration, passing through the Cachapoal bottleneck and the surrounding lands. This is further supported by three previous observations: 1) Three satellite tracked adults captured in their breeding grounds in southwestern Argentina migrated through the western Andes of Chile (Sympson et al. 2006, Bechard et al. 2010, Sympson pers. com.); 2) All autumn migrants observed at the northern breeding limit of the species in Argentina headed for Chile, taking advantage of the prevailing westerly winds that deflect upwards, and "slope-soar" their way to the north (Juhant & Seipke 2010); and 3) The absence of records of White-throated Hawks migrating northward through the eastern slopes of the Argentinean Andes between 37°S–32°S (Trejo et al. 2007, Rivas-Fuenzalida et al. 2023).

Just 90 km north of the Cachapoal site, some migrants seem to cross the Andes to Argentina through the Farellones area, as noted by Rivas-Fuenzalida et al. (2017) and by us in this study. In fact, the only record of the species on the eastern slopes of the Andes at that latitude was ca. 80 km east of Farellones in Manzano Historico Natural Reserve, Mendoza (Pereyra et al. 2021). From Farellones, those hawks likely continue through the eastern Andes flyway to the Yungas of northern Argentina, Bolivia, and Peru (Trejo et al. 2007, Rivas-Fuenzalida et al. 2017, Figure 1). Consequently, migration numbers in the western Andean flyway of northern Chile and southern Peru might not be representative of the whole breeding population, and may explain the low numbers of White-throated Hawks reported in Arica and Parinacota, Chile (Medel et al. 2018, Rivas-Fuenzalida & Quispe-Flores 2021), and in Arequipa, Peru (Vásquez & Allasi 2017). Moreover, some coastal breeders use the Coastal Mountain Range as a migratory corridor up to 31°S (Rivas-Fuenzalida et al. 2017). Thus, a hypothetical bottleneck where almost all White-throated Hawk breeding population pass by does not exist, and the best point for population counting is in the Andes of

central Chile (Cachapoal watch site and surrounding areas), before the flocks split towards the east and west flyways (Figure 1).

Percentage of the global White-throated Hawk breeding population using the Cachapoal bottleneck. Current population estimates of 670–6,700 mature individuals (BirdLife International 2023) are based on deficient and outdated data of a species with a very huge breeding distribution of 4,500,000 km², which ignores the fact that the species is an obligated migrant with a breeding range restricted to the forests of Chile and western Argentinean Patagonia (which does not exceed 155,000 km²; Rivas-Fuenzalida et al. 2023, Rivas-Fuenzalida unpublished). Thus, an adequate estimation of the proportion of the global breeding population using the Cachapoal bottleneck is not yet possible to calculate with that data. However, as a preliminary approximation, we can infer that the Andean breeding population of Chile and Argentina correspond to at least 84% of the global breeding population based on 1) citizen science data and 2) suitable breeding habitat distribution. Our estimation, based on presence data from eBird (N = 595 records in suitable habitat during the breeding period), reveal that at least 83.7% of the global population occupy the Andean Mountain Range, and the remaining 16.3% occupies the Coastal Mountain Range and Intermediate Ranges (eBird 2023). Although these data may be biased by differences in sampling effort between areas and/or the variable bird identification skills of observers, they agree very well with the second source of information. Roughly, the suitable habitat in the Andean Mountain Range is 84% (130,000 km²), while the Coastal Mountain Range plus Intermediate ranges of Chile account for 16% of suitable habitat (25,000 km², Rivas-Fuenzalida unpublished).

Since breeding pair densities are much higher in the Andes than in the Coastal and Intermediate ranges (Rivas-Fuenzalida et al. 2023), the breeding population in the Andes would be even higher than 84% of the global breeding population. Thus, conservatively, we can establish that ≥84% of the breeding population is concentrated in the Andean temperate forests of Chile and Argentina. If the whole Andean breeding population uses the Cachapoal bottleneck, the numbers we observed seem very low (for a 130,000 km² breeding area in the Andes) and could mean that 1) we may have missed individuals, or 2) the species has a very low breeding population (2,000–2,500 breeding pairs).

Conservation implications and future research. Giving that the available information indicates that most of the global breeding population concentrates in the Andean temperate forests of southern Chile and Argentina, to test the idea that almost all Andean breeding population passes by Cachapoal site and surrounding lands during the autumn migration be-

Table 1. Records of White-throated Hawks *Buteo albigula* migrating from south to north during the austral autumn at five watch sites in Chile and Argentina.

Locality (year)	Country	Sampling effort (hr)	Passage rate (birds/hr)	Average daily passage (birds/day)	Total hawks per season	Reference
Moquehue (2008)	Argentina	93	1.0	6	96	Juhant and Seipke 2009
Lonquimay (2004-2005)	Chile	9.5	3.6	17.5	35	Trejo et al. 2007
Farellones (1996-1998)	Chile	236	1.1	9.8	256	Pavez 2000
Farellones (2022)	Chile	21	7.2	50.7	152	This study
Arica Parinacota (2015)	Chile	162	1.8	16.3	294	Medel et al. 2018
Cachapoal (2022)	Chile	33	30.9	204	1,020	This study
Cachapoal (2023)	Chile	224	24.4	193.7	5,424	This study

comes a primary task. To test this proposal, it is necessary 1) to tag more individuals with GPS transmitters (and VHF transmitters) through the Andes of southern Chile, southwestern Argentina, southern portions of the Coastal Mountain Range in Chile, and in the Yungas of northwestern Argentina, and 2) to establish further watch sites east and west of the Cachapoal watch site, ideally including the eastern slope in Argentina.

Given that certainly a high proportion of the breeding White-throated Hawk population and many Variable Hawks use the Cachapoal bottleneck and the Andean foothills of central Chile as a main migratory corridor, these areas are very important for their conservation and must be protected in the long term. Thus, avoiding or carefully carrying out energy generation or transmission projects (i.e., wind farms, transmission lines, etc.) along these areas is pivotal for the conservation of these and other threatened raptor species with large home-ranges, such as the Andean Condor (*Vultur gryphus*; Pavez 2014). Moreover, additional monitoring data are needed to verify the altitudes, flight patterns, and passage sites observed in this study. Future capture and banding efforts in this site would provide valuable information on body condition during migration, molt patterns, body measurements variation, blood sampling for genetic studies, and other issues. The conservation status of the White-throated Hawk was recently changed to Near Threatened in Chile (MMA 2020); thus, continuing with the long-term counting in Cachapoal is crucial to monitor possible population fluctuations in this key species, which appear to be at low numbers and can act as an indicator of the state of health of the southern temperate forests, which are vulnerable to climate change impacts.

ACKNOWLEDGMENTS

This study was possible thanks to the funding of Foundation for International Aid to Animals FIA (fieldwork 2022) and Project Soar Award granted to Tomás Rivas Fuenzalida by The Hawk Mountain Sanctuary Association (fieldwork 2023). We want to think to Jorge Toledo, Álvaro García, Ignacio Celis and Francisco Gajardo for their help during fieldwork. We also think to Cristian M. von Reitze and Laurie Goodrich for essential support, to Christian González, Eduardo Pavez, and Lorenzo Sympson for sharing information, to Jorge Toledo for donating equipment, to Daniel Martínez Piña for collaborating with its art, and to Eduardo Donoso for his hospitality in Cachapoal. We thank Laurie Goodrich for reviewing the first version of this manuscript. Detailed suggestions and criticism by Carlos Bosque, reviewer Valeria Ojeda, and an anonymous reviewer contributed significantly to improve the quality of this manuscript. Special thanks to Peter Lowther and Dan Brooks for their help through the Editorial Assistance Program.

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