LATE-SUMMER PRESENCE OF THE PATAGONIAN TYRANT, *COLORHAMPHUS PARVIROSTRIS* (DARWIN) ON NAVARINO ISLAND, CAPE HORN COUNTY, CHILE

PRESENCIA DE LA VIUDITA, *COLORHAMPHUS PARVIROSTRIS* (DARWIN) A FINES DE VERANO EN ISLA NAVARINO, COMUNA CABO DE HORNOS, CHILE.

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ABSTRACT

The southernmost representative of the Tyrannidae, a diversified family with approximately 420 species endemic to the Americas, belongs to a monotypic genus *Colorhamphus* with only one species: *C. parvirostris*. Little is known about the Patagonian tyrant, which is considered rare throughout its breeding range and vulnerable to forest disturbances and habitat fragmentation. Even its distribution and life history are poorly known. During the breeding season it migrates to higher latitudes (>40°S) in southern Chile and Argentina, but small numbers remain within central-southern latitudes year-round (30-40°S). In the high latitudes of Tierra del Fuego it is said to be an accidental visitor, but records of *C. parvirostris* are extremely rare.

As part of the long-term mistnetting and bird census program at the Omora Ethnobotanical Park on Navarino Island, Cape Horn County, Chile (55° S) a total of 1,542 birds belonging to 17 species have been captured with mistnets on Navarino Island. Only 12 were *C. parvirostris* (<1%). Therefore, this species is indeed rare. However, from 2000 to 2003 all of the few Patagonian tyrants have been captured from late March and April. Its presence on Navarino Island could have become more frequent due to an extension of its latitudinal range associated with global climate change. However, additional observations made on successive years during late summer and fall suggest an alternative, and perhaps complementary, explanation – a short southward migration performed by some individuals prior to their northward migration. This would be the first time that this phenomena is reported for the Southern Hemisphere. Taken together these two hypotheses could re-enforce one other, whereby the southern limit of post-reproductive southerly migrations could be extending due to global warming.

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Key words: *Colorhamphus parvirostris,* Navarino Island, mist-netting, reverse migration, Sub-Antarctic forests, Tyrannidae.

RESUMEN

El representante más austral de Tyrannidae, familia endémica de América que posee unas 420 especies, pertenece al género monotípico *Colorhamphus*, con una única especie como representante, *C. parvirostris*. Poco se conoce acerca de esta especie, la viudita, que es considerada como rara y vulnerable a la degradación y fragmentación del hábitat. Incluso su distribución e historia de vida son poco conocidas. Durante la estación reproductiva las poblaciones migran a latitudes australes (>40°S) en el sur de Chile y Argentina, pero algunos individuos permanecen en latitudes del centro sur (30-40°S). En el extremo sur, en Tierra del Fuego, los registros de *C. parvirostris* son extremadamente escasos y se la ha considerado un visitante accidental.

Como parte del programa a largo plazo de censo y anillamiento de aves en el Parque Etnobotánico Omora, isla Navarino, Comuna Cabo de Hornos, Chile (55° S) se capturó un total de 1.542 aves correspondientes a 17 especies en la isla Navarino. Sólo 12 individuos (<1%) eran de *Colorhamphus parvirostris*. En consecuencia, ésta puede ser considerada una especie rara. Primero, especulamos que la mayor presencia de esta especie en la isla Navarino podría estar relacionada con una extensión de su ámbito de distribución asociada al cambio climático global. Sin embargo, observaciones adicionales de *C. parvirostris* en años sucesivos que se restringían al verano tardío y otoño nos sugirieron una explicación alternativa: una corta migración sur efectuada por algunos individuos antes de emprender su migración hacia el norte, que constituiría el primer caso de esta conducta conocido para el hemisferio sur. Tomado en conjunto estas dos hipótesis podrían reforzarse, lo que significaría que el límite austral de la migración reversa post-reproductiva podría extenderse debido al calentamiento global.

Palabras clave: anillamiento de aves, bosques subantárticos, *Colorhamphus parvirostris,* isla Navarino, migración reversa, Tyrannidae.

INTRODUCTION

Tyrannidae (tyrant flycatchers) is a family endemic to the Americas (Welty 1975), which includes about 420 species that inhabit ecosystems from the Canadian arctic tree-line to Patagonia (Clark 2001). *Colorhamphus* is a monotypic genus with only one species: *C. parvirostris* (Darwin), or the Patagonian tyrant (Araya *et al.* 1996, Fjeldsa & Krabbe 1990). In large part its distribution and life history are poorly known (Marin *et al.* 1989, Chesser & Marin 1994). It is a small insect-eating bird (Rozzi *et al.* 1996a, b), and it migrates to higher latitudes (>42°S) in southern Chile and Argentina during the austral Spring and Summer (October-March), to later return to central-southern latitudes (Fig. 1). It is uncommon throughout all of its breeding range (Chesser & Marin 1994, Ridgely & Tudor 1994) and has been considered vulnerable to forest disturbances and habitat fragmentation (Cofre 1999, Willson *et al.* 1994). Most breeding populations exhibit a southward migration in the spring, but small numbers remain within the northern part of the breeding range all year long (Chesser & Marin 1994). In the high latitudes of Tierra del Fuego and Cape Horn it is said to be an accidental visitor. Humphrey *et al.* (1970) comment that:

«Philippi *et al.* (1954) stated that from comments by Reynolds and others they had hoped to be able to study the nesting of this little flycatcher during their trips to the southern regions, but it was so rare there that they were disillusioned. They never saw or heard it anywhere on Isla Grande (Tierra del Fuego).»

Indeed, south of the Straits of Magellan records of *C. parvirostris* are very scarce. Previously published records for this

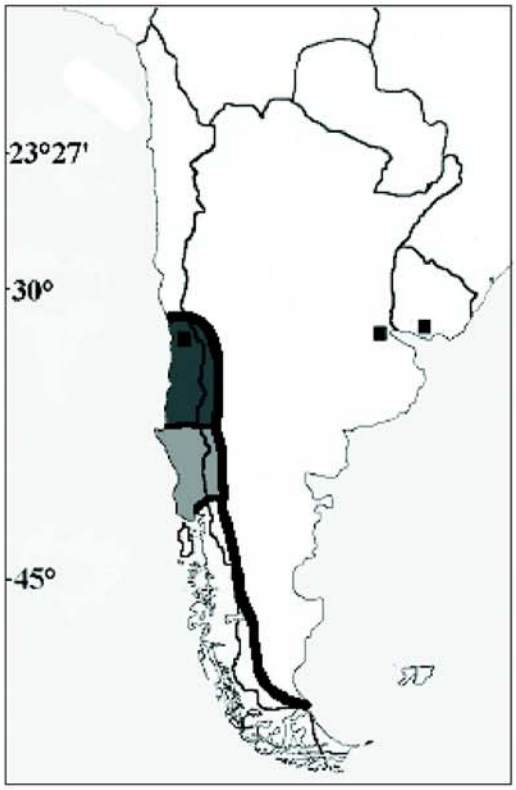

Fig. 1. Distribution map of *Colorhamphus parvirostris*; the black line delimits the restriction of its range to the southern temperate forests. The darkest grey area shows winter distribution, the intermediate shading represents year-round range and the white zone demonstrates summer distribution all the way south to Isla Navarino (Figure modified from Rozzi et al. 2003).

species south of the strait are: 1) a male collected in Lapataia, Tierra del Fuego in 1895 (Schalow 1898); 2) a specimen collected at False Cape Horn, southern Isla Hoste in 1895 (Schalow 1898); 3) a pair seen in January 1977 near Seno Ponsonby, Isla Hoste (Sielfeld 1977); and 4) an individual captured by mistnet in March 2000 on the northern coast of Isla Navarino (Anderson & Rozzi 2000). The latter authors suggested that the presence of *C. parvirostris* on Navarino Island might become more frequent in relation to an extension of its latitudinal range associated with global climate change. Such southward expansions of latitudinal ranges have been already reported and discussed for other species in southern Chile (McGehee *et al.* 1999).

In this article, we report additional observations of Patagonian tyrants made at the southern tip of their range and discuss an alternative, and perhaps complementary, explanation to its presence on Navarino Island – the possibility of a short southward migration performed by some individuals prior to their northward migration. This pattern is common in other migratory passerine birds and can occur in both autumn (post-reproductive) and spring (pre-reproductive). Orientation errors, effect of wind drift and response to unsuitable weather have been suggested as possible explanations for reoriented movements (Åkesson *et al.* 1996, Åkesson 1999, Åkesson & Sandberg 1999), but it is also possible that reverse migration is an adaptive strategy when species encounter ecological barriers that must be crossed (Åkesson 1997, Bruderer & Liechti 1998).

If such patterns are exhibited by *C. parvirostris*, then we should expect the presence of Patagonian tyrants at high latitudes on Navarino Island (55°) in late summer or early fall (post-reproductive season), before their northward migrations. To evaluate this pattern we analyze the abundance of *C. parvirostris* on the northern coast of Navarino Island at different months of the breeding and post-breeding seasons.

Study Area

The study was conducted on Navarino Island (55°S), which is situated between the Cape Horn Archipelago (56°S) and Tierra del Fuego (54°S). Mistnetting was conducted primarily at two sites on the northern coast of the island: the Omora Ethnobotanical Park (54°57′S; 67°39′W), near the town of Puerto Williams, and on Guerrico Hill (54°55′S; 67°54'W) (Fig. 2). To complement and expand the study done on the northern coast of Navarino Island, mistnetting was also done at three sites on the western coast of Navarino Island: Puerto Inútil (54°59'S; 68°13'W), Wulaia (55°03′S; 68°09′W) and Douglas Bay (55°05′S; 68°09′W), during January and February 2000. All sites are relatively low elevation, ranging from sea-level to 100 m.

The Omora Ethnobotanical Park comprises a mosaic of diverse forest types, which include old growth forests dominated by

TABLE 1. Mistnet effort per month during the study period on Navarino Island. Mistnet effort was calculated as the number of hours each mistnet was open multiplied by the area of each mistnet (length*height of the mistnet). Percentage of *Colorhamphus parvirostris* is calculated as (Number of caught *C. parvirostris*/Number of caught birds)*100.

Year	**Month**	**Mistnet hours**	**Mistnet effort ($h*m^2$)**	**Number of birds caught**	**Number of caught *C. parvirostris***	**Percent *C. parvirostris* (%)**
2000	January	59.3	1796.2	43	0	0
2000	March	63.3	2258.1	40	1	2.5
2000	May	59.1	2111.3	52	0	0
2000	September	19.1	711.3	10	0	0
2000	November	108.3	3988.4	112	0	0
2000	December	144.4	4348.5	85	0	0
2001	January	156.2	5517.7	165	0	0
2001	February	41.3	1287.5	32	0	0
2001	December	15.1	545.3	12	0	0
2002	January	363.1	11328.2	129	0	0
2002	February	166.4	5190.1	165	0	0
2002	March	193.5	6035.6	150	3	2.0
2002	April	181.3	6015.1	183	4	2.2
2003	January	67.8	2035.8	24	0	0
2003	February	137.1	5544.2	90	0	0
2003	March	144.1	7284.4	60	2	3.3
2003	April	70.8	6290.4	99	2	2.0
2003	May	33.9	3351.4	91	0	0
Total		**2023.7**	**75639.7**	**1542**	**11**	**0.7**

TABLE 2. Bird species captured with mistnets from January 2000 to May 2003. Shown in the right column is each species' relative abundance, as a percentage of total captures (N=1542).

Scientific name	**Common name**	**Relative percentage (%)**
Anairetes parulus	Tufted-tit tyrant	2.2
Aphrastura spinicauda	Thorn-tailed rayadito	20.2
Carduelis barbata	Black-chinned siskin	6.0
Cinclodes fuscus	Bar-winged cinclodes	0.3
Cinclodes patagonicus	Dark-bellied cinclodes	0.2
Colorhamphus parvirostris	**Patagonian tyrant**	**0.7**
Elaenia albiceps	White-crested elaenia	17.8
Enicognathus ferrugineus	Austral parakeet	0.4
Glaucidium nanum	Austral pygym owl	0.4
Phrygilus patagonicus	Patagonian sierra finch	35.2
Pygarrhichas albogularis	White-throated treerunner	0.7
Sephanoides galeritus	Green-backed firecrown	0.7
Tachycineta meyeni	Chilean swallow	1.6
Troglodytes aedon	Magellanic wren	8.0
Turdus falcklandii	Austral thrush	1.2
Xolmis pyrope	Fire-eyed diucon	0.7
Zonotrichia capensis	Rufous-collared sparrow	3.7

TABLE 3. Presence/absence on Navarino Island during pre-reproductive, reproductive, and post-reproductive seasons, of *Colorhamphus parvirostris*, and four other common species: two residents (*Aphrastura spinicauda* and *Phrygilus patagonicus*), and two migratory (*Elaenia albiceps* and *Troglodytes aedon*).

Season	Resident species		Migratory species		
	Aphrastura spinicauda	*Phrygilus patagonicus*	*Troglodytes aedon*	*Elaenia albiceps*	*Colorhamphus parvirostris*
Reproductive 2000 (January)	1	1	1	1	0
Post-reproductive 2000 (March)	1	1	0	1	1
Pre-reproductive 2000 (May and September)	1	1	0	0	0
Reproductive 2000-2001 (November-February)	1	1	1	1	0
Reproductive 2001-2002 (December-January)	1	1	1	1	0
Post-reproductive 2002 (March-April)	1	1	1	1	1
Reproductive 2003 (January-February)	1	1	1	1	0
Post-reproductive 2003 (March-April)	1	1	0	1	1
Pre-reproductive 2003 (May)	1	1	0	0	0

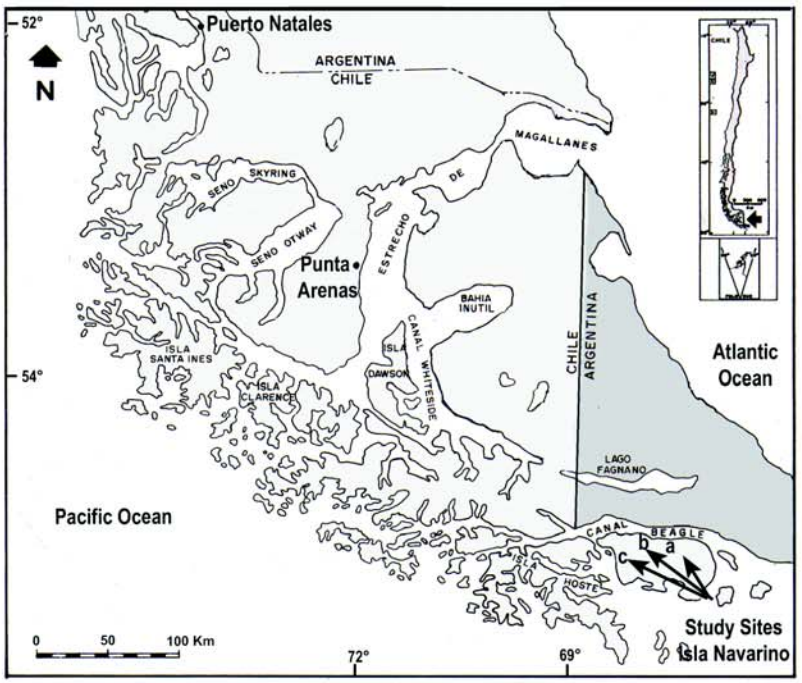

Fig. 2. Study sites on Navarino Island (55°S): a = Omora Ethnobotanical Park; b = Guerrico; c = West coast of Navarino (Puerto Inútil, Wulaia, Douglas Bay).

Nothofagus species, as well as naturally and anthropogenically perturbed forests. Among the latter is a shrubland area dominated by the firebush (*Embothrium coccineum*), adjacent to evergreen forests of *Nothofagus betuloides* on a north-facing slope of Robalo Mountain. The other site on Navarino Island is a gentle, north-facing slope on Guerrico Hill (54°55′S; 67°54'W), which is also dominated by *E. coccineum*. This area is a fire regenerated forest of *Nothofagus betuloides* and *N. pumilio*, adjacent to the main dirt road along the northern coast of Navarino Island. As in Omora Park, the landscape near Guerrico comprises forests subject to natural and anthropogenic perturbations, including forest burning, wood-cutting, livestock ranching, and disturbance effects of the introduced beaver (*Castor canadensis*) since the 1960s (Sielfeld & Venegas 1980).

Navarino Island is characterized by an oceanic climate type with a mean annual temperature of 5.6°C and an annual temperature fluctuation of less than 10°C (Rozzi 2002[1]). Moreover, minimum temperatures below 0°C prevail only during the winter months of July and August, and rarely are lower than 5°C. In 2000, minimum mean temperature was 1.6°C and maximum mean temperature was 10.2 °C (Rozzi 2002)[1]. The average annual rainfall in Puerto Williams is less than 500 mm, and in the year between November 1999 and October 2000 total precipitation was 429 mm (Rozzi 2002)[1].

MATERIALS AND METHODS

We studied the presence and abundance of forest bird species using mist-netting (permits granted by the *Servicio Agrícola y Ganadero* to S. McGehee and R. Rozzi) (for further details on mistnetting program see Anderson & Rozzi 2000, Anderson *et al.* 2002). A total of 2,023.54 hours of mist-netting were done on Navarino Island a between January 2000 and May 2003 (Table 1). Mistnets had a grid of squares with a diagonal of 30 mm. The nets were checked every 15 to 30 min. Each sampling used a number of mistnets of 6 m long by 2.6 m height and/or 12x2.6 m. In order to standardize the sampling effort for each site, we considered the size of the net and the time of display. The products of the net-area (m^2) and the number of hours of net display (based on the time of installation and removal of each net) were calculated for each net and sampling day and summed up for each sampled month as h* m^2 (Table 1).

To compare presence/absence of *Colorhamphus parvirostris* during the post-reproductive season and the rest of year, we used Fisher exact test comparing the presence/absence of *C. parvirostris* with four other species: two residents (*Aphrastura spinicauda* and *Phrygilus patagonicus*), and two migratory (*Elaenia albiceps* and *Troglodytes aedon*). We defined the reproductive season as the period November – February, post-reproductive season from March to May, and pre-reproductive season from June to October.

RESULTS

In total, 1,542 individuals belonging to 17 forest bird species were caught with mist-nets on Navarino Island (Table 2). The most abundant species were *Aphrastura spinicauda*, *Phrygilus patagonicus, Carduelis barbata, Troglodytes aedon,* and *Elaenia albiceps*. In total, only 12 *Colorhamphus parvirostris* individuals were captured over four years, which is 0.7% of all birds caught. Therefore, *C. parvirostris* indeed can be considered a rare species for the avifauna of the forests of Navarino Island.

When analyzing the data for each month, an interesting pattern emerges: all *C. parvirostris* individuals were captured during the months of March or April. No Patagonian tyrants were caught during other months, even in months when bird abundances were extremely high with totals of more than one hundred birds captured per day (*e.g.* November 2000, January 2001, January and February 2002). On the other hand, during the months of March and April, captured

1 Rozzi, R. 2002.Biological and Cultural Conservation in the Archipelago Forest Ecosystems of Southern Chile. Ph.D. Dissertation, Department of Ecology and Evolutionary Biology, University of Connecticut, USA.

C. parvirostris represented more than 2% of the total birds captured with mistnets. Therefore, the recorded presence of the Patagonian tyrant on Navarino Island has been restricted to the post-reproductive season.

To test and contrast the temporal pattern of *C. parvirostris* presence on Navarino Island, we compared its frequency of presence/absence during pre-reproductive, reproductive, and post-reproductive months, and we performed the same comparisons for four other species, two resident and two migratory (Table 3). A Fisher exact test, shows that the temporal distribution of Patagonian tyrant restricted to the post-reproductive season (March and April) is significant (Fisher exact test, $p=0.012$). For the other four species, no significant difference was found regarding their pre-reproductive, reproductive and post-reproductive seasonal presence on Navarino Island: *T. aedon* (Fisher exact test, $p>0.5$), *E. albiceps* ($p>0.5$), *A. spinicauda* ($p>0.9$) and *P. patagonicus* ($p>0.9$). Therefore, *C. parvirostris* presents a distinct pattern of post-reproductive presence on Navarino Island, compared to other resident and migratory passerines.

DISCUSSION

Other than one sighting of a pair of *Colorhamphus parvirostris* on Isla Hoste (Sielfeld 1977), there was no previous evidence of breeding on the islands south of Tierra del Fuego (Johnson 1967). Most Patagonian tyrants migrate further north in Chile and Argentina from their nest sites, and only one bird has been recorded south of 43 degrees during the austral winter (Chesser & Marin 1994). Our long-term mistnetting and banding program at the Omora Ethnobotanical Park first detected this species on Navarino Island in March 2000 (Anderson & Rozzi 2000). This study confirms the presence of *C. parvirostris* on Navarino Island to be more than a one time event. However, it is intriguing that this species was not reported previously for Navarino Island, and that the Patagonian tyrant is the only forest bird species that lacks a Yaghan name (Massardo & Rozzi 2004).

The Yaghan culture has a rich ornithological knowledge (Rozzi *et al.* 2003, Rozzi 2004), and the lack of name for this species, which has a characteristic and conspicuous call, suggests that the Patagonian tyrant may have not been present on Navarino Island and the Cape Horn archipelago region in earlier times. Consequently, Anderson & Rozzi (2000) suggest that the presence of *C. parvirostris* on Navarino Island today, might correspond to a recent latitudinal extension of its distribution range. Recent extensions for distribution ranges detected for bird species at high latitudes have been associated with global change (see McGehee *et al.* 1999), and the presence of the Patagonian tyrant might be a new case.

However, if this were the only reason for the presence of Patagonian tyrant in Cape Horn County, then one could expect to find them at any time of the Spring or Summer. The fact that the presence of *C. parvirostris* is restricted to the months of March and April seems to confirm our hypothesis of a reverse migration in autumn, because in this season the normal migration route would be toward the north. It is important to note that global warming could also be a contributing factor that has extended this reverse migration further southwards. A short southward migration performed by some Patagonian tyrants prior to their northward migration might represent the first reported case of reverse post-reproductive migration for the Southern Hemisphere. Post-reproductive reverse migration, or pre-migratory vagrancy, seems to be common among some migratory passerine birds in the Northern Hemisphere (Åkesson et al. 1996, Åkesson 1997, Bruderer & Liechti 1998, Åkesson 1999, Åkesson & Sandberg 1999), but this phenomenon previously has not been observed in southern temperate latitudes.

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LITERATURE CITED

Åkesson, S. 1997. *Bimodal orientation and the adaptive significance of temporary reverse bird migration in autumn.* The Royal Institute of Navigation. Oxford.

Åkesson, S. 1999. Do Passerine migrants captured at an inland site perform temporary reverse migration in autumn? *Ardea* 87: 129-137.

Åkesson, S., L. Karlsson, G. Walinder & T. Alerstam 1996. Bimodal orientation and the occurrence of temporary reverse bird migration during autumn in south Scandinavia. *Behav. Ecol. Sociobiol.* 38: 293-302.

Åkesson, S. & R. Sandberg 1999. Ecological barriers and the flexible orientation system of migrating birds. In: Adams, N. J. & Slotow, R. H. (eds) *Proc. 22 Int. Ornithol. Congr.*, Durban: 1005-1016. Johannesburg: BirdLife South Africa.

Anderson, C. & R. Rozzi 2000 «Bird assemblages in the southernmost forests of the world: Methodological variations for determining species composition». *Anales Instituto Patagonia* Serie Cs. Nat.(Chile) 28: 89-100.

Anderson, C., R. Rozzi, C. Elphick & S. McGehee 2002. El programa Omora de anillamiento de aves en los bosques subantárticos: estandarización del tamaño de anillos apropiados para las aves de la Región de Magallanes. *Boletín Chileno de Ornitología* 9: 2-11.

Araya, B., G. Millie & M. Bernal 1996. *Guía de Campo de las Aves de Chile.* 7ª edicion, Editorial Universitaria, Santiago, Chile.

Bruderer, B. & F. Liechti 1998. Flight behaviour of nocturnally migrating birds in coastal areas - crossing or coasting. *J. Avian. Biol.* 29 (4): 499-507.

Chesser, R.T. & M. Marin 1994. Seasonal distribution and natural history of the Patagonian Tyrant (*Colorhamphus parvirostris*). *Wilson Bull.* 106:649-667.

Clark, G. 2001. Tyrant Flycatchers. In *The Sibley Guide to Bird Life & Behavior* (Elphick, C., J. Dunning & D. Sibley, eds) pp. 384-398. Alfred A. Knopf, New York.

Cofré, H. 1999. Patrones de rareza de las aves del bosque templado de Chile: implicancias para su conservación. *Boletín Chileno de Ornitología* 6:8-16.

Fjeldsa, J. & N. Krabbe, 1990. *Birds of the High Andes.* Zoological museum, University of Copenhagen, Svendberg, Denmark.

Humphrey P.S., D. Bridge, P.W. Reynolds & R.T. Peterson 1970. *Birds of Isla Grande* (Tierra del Fuego). Smithsonian Institution. Washington DC.

Johnson, A.W., 1967. *The birds of Chile and adjacent regions of Argentina, Bolivia and Peru* Vol 2, Platt Establ. Gráficos, Buenos Aires, Argentina.

Marin, M., L. Kiff & L. Pena 1989. Notes on Chilean birds, with descriptions of two new subspecies. *Bul. British Orn. Club* 109:66-82.

Massardo, F. & R. Rozzi 2004. Etno-ornitología yagán y lafkenche en los bosques templados de Sudamérica austral. *Ornitología Neotropical* 15: 395-407.

McGehee, S., R. Rozzi, J.C. Torres-Mura & M. Willson 1999. Observaciones del bailarín (*Elanus leucurus*) en Chiloé (X Región). *Boletín Ornitológico de Chile* 6: 22-24.

Moore, D.M. 1983 *Flora of Tierra del Fuego.* Anthony Nelson, England.

Philippi, R.A., A.W. Johnson, J.D. Goodall & F. Behn 1954. Notas sobre aves de Magallanes y Tierra del Fuego. *Bol. Mus. Nac. Hist. Nat.* 26:1-65.

Ridgely, R.S. & G. Tudor 1994. *The Birds of South America.* Vol 2, University of Texas Press, Austin.

Rozzi, R. 2004. Implicaciones éticas de narrativas yaganes y mapuches sobre las aves de los bosques templados de Sudamérica austral. *Ornitología*

Neotropical 15: 435-444.

Rozzi, R., D. Martínez, M.F. Willson & C. Sabag 1996a. Avifauna de los Bosques Templados de Sudamérica. In *Ecología de los Bosques Nativos de Chile* (J.J. Armesto, C. Villagrán & M.T. Kalin, eds.), pp: 135-152. Editorial Universitaria, Santiago, Chile.

Rozzi, R., J.J. Armesto, A. Correa, J.C. Torres-Mura & M. Sallaberry 1996b. Avifauna de bosques primarios templados en islas deshabitadas del archipiélago de Chiloé. *Revista Chilena de Historia Natural* 69: 125-139.

Rozzi R., F. Massardo, J. Silander Jr., C. Anderson & A. Marin 2003. Conservación biocultural y ética ambiental en el extremo austral de América: oportunidades y dificultades para el bienestar ecosocial. In «*Biodiversidad y Globalización*» (Figueroa E & J Simonetti, eds.), pp. 51-85. Editorial Universitaria, Santiago, Chile.

Schalow, H. 1898. Die Vogel der Sammlung Plate. Zool. Jahr. Suppl. 4: 641-748.

Sielfeld, W. 1977. Reconocimiento macrofaunístico terrestre en el área del Seno Ponsonby (Isla Hoste). *Anales Instituto Patagonia* (Chile) 8: 275-296.

Welty, J. 1975. *The Life of Birds*. W.B. Saunders. Philadelphia, USA.

Willson, M.F., T.L. de Santo, C. Sabag & J.J. Armesto 1994. Avian communities of fragmented South-temperate rainforests in Chile. *Conservation Biology* 8: 508-520.