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ECOLOGY AND BEHAVIOR OF ALDER FLYCATCHERS (*EMPIDONAX ALNORUM*) ON THEIR WINTERING GROUNDS IN ARGENTINA

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ABSTRACT.—The Alder (*Empidonax alnorum*) and Willow (*E. trailli*) flycatchers are cryptic species, and their distribution outside the breeding season is poorly known, owing mostly to identification difficulties. Our new records suggest that large numbers of Alder Flycatchers overwinter in rivers crossing the Chaco region and in the foothill forests of the Yungas of Argentina, significantly increasing their southern wintering range. Records in northern Argentina span 3 November to 23 March. Key habitat for overwintering Alder Flycatchers in Argentina included stands of palo bobo (*Tessaria integrifolia*) along the Río Bermejo and tributaries, either in association with sparse shrubs of chilca (*Baccharis salicifolia*) or more rarely with canebrake (*Gynerium sagittatum*). Other habitats used were old shrubby 'madrejones' with *Tessaria* scrub and sacha café (*Sesbania virgata*), very dense *Baccharis salicifolia* scrub next to flowing creeks in foothill Yungas and dry Chaco, and riparian forests dominated by palo flojo (*Albizia inundata*) and timbó (*Enterolobium contortisiliquum*). Seasonal flooding of these habitats did not affect the presence of Alder Flycatchers. Small territories of c. 20 × 20 or 25 × 25 m were defended in *Tessaria* stands. Alder Flycatchers fed mostly on insects in flight (aerial hawking), but also on green Lepidoptera larvae (upward sally-strikes), and on insects on leaves, and ripe fruits of tala (*Celtis* cf. *ehrenbergiana*) in forest understory (clinging). Vocalizations given by overwintering birds (*fee-bee-oo, zwee-oo, wee-oo, churr, pit, double-peak*, and *kitter*) were similar to those used while breeding. Alder Flycatchers collected in Argentina had significantly longer wings and wider bills than specimens from the sympatric Euler's Flycatchers (*Lathrotriccus euleri*) from Argentina with which it has been confused in museum specimens. *Received 11 November 2015. Accepted 31 January 2016.*

Key words: Argentina, Chaco, cryptic species, distribution, seasonality, South America.

The Alder (*Empidonax alnorum*) and Willow (*E. trailli*) flycatchers are cryptic species. Identification of them based on external features is difficult and not always possible (Stein 1963, Seutin 1991, Pyle 1997). Both taxa were considered conspecific until differences in vocalizations (tested with playback experiments) and habitat use led to their recognition as separate species (Stein 1958, 1963), which is also supported by genetic data (Zink and Johnson 1984, Seutin and Simon 1988). Vocalizations provide the most robust means of identification in the field (Whitney and Kaufman 1986). Alder Flycatchers give a *pit* call and *fee-bee-o* song and Willow Flycatchers a *whit* call and *fitz-bew* song, among other vocalizations (Kroodsma 1984; Sedgwick 2000, 2001; Foster 2007; Lovell and Lein 2013). Both species breed in northern North America and are long-distance migrants to the south outside the breeding season. Alder Flycatchers breed farther north than Willow Flycatchers, and while Alder Flycatchers presumably overwinter in central and southern South America, Willow Flycatchers overwinter in northern South America and in Central America (Ridgely and Tudor 1994, Lowther 1999, Paxton et al. 2011). Pioneer efforts by Gorski (1969, 1971) using vocalizations to aid field identification were paramount in beginning to elucidate wintering ranges of these species. However, the distributions of both species outside the breeding season are still poorly known, owing mostly to identification difficulties (Lowther 1999, Colorado 2010). For example, recent re-identification of specimens through genetic markers revealed that a large number of Alder Flycatchers were misidentified as Willow Flycatchers, showing in turn that the vast majority of individuals in a presumably important area of migratory passage for both flycatchers in southeastern Mexico were Alder Flycatchers (Novitch et al. 2015).

The southern distributional limit of regularly overwintering Alder Flycatchers is thought to lie in

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northern Argentina; however, all documented (specimen) records of this species were reported by people not directly involved in specimen acquisition and lack any reference to vocalizations (Appendix S1). Thus, although it could be assumed that specimens are Alder Flycatchers, no effort was made to test their identity rigorously, so mapped distributions remain speculative. Moreover, no data on habitat use or behavior were recorded for these specimens, and no recent reports of the species at its southernmost wintering range have been documented. Except for Foster's (2007) paper, little information has been published about the wintering ecology of Alder Flycatchers. In our manuscript, we extend the Boreal winter range of this species significantly, reporting new localities from Argentina. We also characterize habitats used, analyze seasonality, and provide data on feeding, behavior, morphology, and vocalizations.

METHODS

To understand the distribution of Alder Flycatchers in Argentina, we compiled locality records from the literature, sound archives, and third parties, and carried out searches for the species in the provinces of Salta, Jujuy, and Formosa. All records were critically evaluated (by listening to recordings, examining museum specimens, and inquiring on playback-responses to pre-recorded vocalizations) and mapped (Appendix S1).

We took notes on foraging, territoriality, behavior, and habitat use, and obtained sound-recordings and photographs to document aspects of vocal behavior, identification, and molt. We estimated territory sizes through playback (i.e., birds did not move beyond the territory boundaries but vocalized within them) or by observing and listening to interacting birds countercalling in adjacent territories. Seasonality and most natural history data come from a 2-year avifaunal survey carried out at Reserva Natural (RN) Formosa, Formosa province, Argentina (24° 18′ 41" S, 61° 48′ 45" W) between August 2013 and May 2015. This natural ~9000-ha preserve belongs to the Dry Chaco and is bordered by the Río Bermejo in its southern limit. During 99 days of field surveys, we generally walked from dawn to dusk (except in extremely hot summer days, when activity was focused from dawn to noon and from late afternoon to dusk) covering all habitat types in all seasons recording all species detected. Observations of Alder Flycatchers come from field-trips between 8–12 December 2013, 18–24 February 2014, 14–20 March 2014, 21–23 November 2014, 2–7 February 2015, and 2–8 March 2015.

We documented our records through photos (Appendix S2) and sound recordings made using a Telinga Pro 6 Stereo microphone (Telinga, Botarbo, Sweden) mounted on a Telinga 54.7-cm parabola connected to a Marantz PMD661 recorder (Marantz Corp., Kawasaki, Japan) set to record at 24 bit and 48 kHz. All spectrograms were made using the same following parameters in Raven Pro 1.5 (Bioacoustics Research Program 2014); Window: Hann type, size 200 samples = 4.17 ms, and 3-dB filter bandwidth 345 Hz; Time Grid: overlap 50%, and hop size 100 samples = 2.08 ms; frequency grid: DFT size 256 samples, and grid spacing 188 Hz. All recordings are deposited at the Macaulay Library of Natural Sounds (Cornell Lab of Ornithology, Ithaca, NY, USA).

We examined and measured all museum specimens morphologically compatible with the Alder Flycatcher, and also measured a sample and examined all specimens of Euler's Flycatcher (*Lathrotriccus euleri*) housed in three main museums of Argentina: the Museo Argentino de Ciencias Naturales, Buenos Aires (MACN), Instituto Miguel Lillo, Tucumán (FML), and Museo de La Plata, La Plata (MLP). JIA measured the exposed culmen and bill-width at its base to the nearest 0.01 mm using a dial caliper, and wing-chord (unflattened) and tail (base to tip of innermost rectrix) to the nearest 0.5 mm using a metallic ruler.

RESULTS

Distribution

We obtained new records from six localities based on aural identification and/or sound recordings (Fig. 1, Appendix S1). These are the first confirmed records of Alder Flycatcher in Argentina, and the southernmost known with certainty (Fig. 1, Camperi 1986, 1990, Appendix S1). Also, an Alder Flycatcher type bird was mist-netted at a seventh new locality, near a place where specimens were collected in the past (Río Santa María)

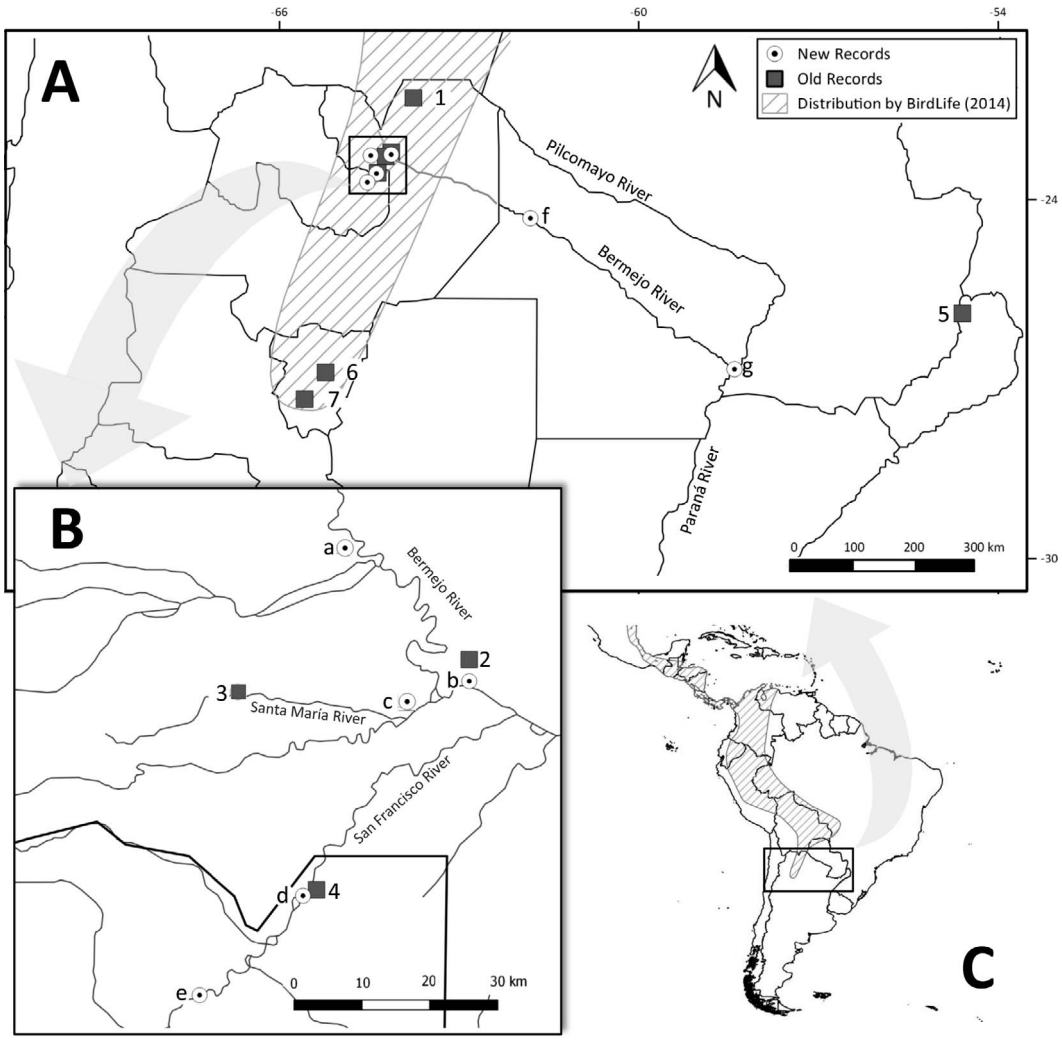

FIG. 1. (A) Distribution of Alder Flycatchers (*Empidonax alnorum*) in Argentina, (B) inset showing detail of clustered records, and (C) distribution in South and Central America *fide* Ridgely et al. (2007). Squares and numbers = previous confirmed specimen localities, circles and letters = new confirmed records. (1) Iquirá, (2) Embarcación, (3) Alto Río Santa María, (4) El Talar, (5) Arroyo Urugua-í, km 10, (6) Laguna La Ripiera, (7) Concepción; (a) Laguna del Palo Pique, (b) Puente Río Bermejo, (c) Río Santa María, (d) Río San Francisco, 2 km W of El Talar, (e) Puente Río San Francisco, (f) Reserva Natural Formosa, and (g) 5 km NW of the mouth of the Río Bermejo. See Appendix S1 and text for more information.

(Fig. 1, Appendix S1). More southerly historical specimen records from Tucumán province likely belong to this species but need confirmation. After examining the specimens, we provisionally accept these records (Fig. 1, Appendix S1). In addition, an Alder Flycatcher type bird was mist-netted at Parque Nacional Copo (Santiago del Estero, Argentina) in late October 2015 (G. S. Cabanne, unpubl. data).

After finding the species in stands of *Tessaria* on the Río Bermejo at RN Formosa, Formosa, we looked for and found it in stands of *Tessaria*/*Gynerium* on the same river 5 km south of Embarcación, Salta (Fig. 1, Appendix S1). We speculate that a specimen from Embarcación without date (Hellmayr 1927), could have been collected on the river margins instead of at Embarcación itself, given the lack of good habitat

for the species in its environs. Similarly, an old specimen reportedly from El Talar, Jujuy, prompted us to visit the nearby stands of *Tessaria* located 2 km west of town on the Río San Francisco where we found two Alder Flycatchers (Fig. 1, Appendix S1). Our northernmost record consists of five individuals in *Tessaria* scrub bordering the Laguna del Palo Pique, Salta, in transitional Yungas foothill (Fig. 1, Appendix S1).

Seasonality

Records of Alder Flycatchers in northern Argentina range from 3 November to 23 March (Appendix S1). At a single well-surveyed locality in the dry Chaco (RN Formosa), we found them regularly between 8 December 2013 and 17 March 2014 (latest departure) and between 22 November 2014 (earliest arrival) and 5 March 2015. We found no birds at RN Formosa during 17–22 October 2013, 24–30 April and 16–21 October 2014, and 3–8 April 2015, which suggests that our extreme dates are fairly representative of the arrival and departure of this migrant at this locality.

Habitat and Territoriality

Key habitat for overwintering Alder Flycatchers included stands of palo bobo or aliso de río (*Tessaria integrifolia*) (57 records, representing over 45 individuals) on sandy soil adjacent to the Río Bermejo and tributaries, either in association with sparse shrubs of chilca (*Baccharis salicifolia*) or more rarely with canebrake (*Gynerium sagittatum*). We never located birds inside dense, tall, mature, and continuous monospecific stands of *Tessaria*; birds were found at borders or near openings in the vegetation. Other habitats used were old shrubby 'madrejones' (i.e., seasonally flooded oxbow lakes that have lost connection to the river course) with *Tessaria* scrub and sacha café (*Sesbania virgata*) (three records/individuals), very dense *Baccharis salicifolia* scrub next to flowing creeks in foothill Yungas and dry Chaco (six records/individuals), and riparian forests with trees of palo flojo (*Albizia inundata*), timbó (*Enterolobium contortisiliquum*), and algarrobo blanco (*Prosopis alba*), and understory dominated by *Solanum* sp., ancoche (*Vallesia glabra*), and tala gateador (*Celtis* sp.) (seven records/individuals). These habitats can flood when the water levels of the Río Bermejo and its tributaries increase during the rainy season (Dec–Mar). Flooding did not appear to disturb the Alder Flycatchers; at least 8 territories discovered before flooding were occupied until the end of the season despite 2 months of flooding with water ~15 cm deep. We saw one bird in a dry forest of palo santo (*Bulnesia sarmientoi*) and quebracho colorado santiagueño (*Schinopsis lorentzi*) foraging with a Plain Inezia (*Inezia inornata*). It moved at a height of 4.5 m, some 250 m from the nearest stand of *Tessaria* along the Río Bermejo.

Birds were territorial and defended small areas of c. 20×20 (=0.04 ha) or 25×25 m (=0.0625 ha) in stands of *Tessaria* ($n = 8$). All territories appeared to be held by a single bird, and all were contiguous to another territory or nearly so. Territories were generally established close to edges of mature stands of *Tessaria* with lower succesional *Tessaria*, lower *Baccharis* scrub, open sandy beaches, forest borders, and lagoons in madrejones. A few territories (territory size not estimated) were located in riparian forest dominated by the open canopied palo flojo and timbó.

Feeding

Alder Flycatchers fed on insects in flight, making 5–15-m-long slightly ascending horizontal sallies (aerial hawking) and returning to the same or to a nearby perch 3–7 m from the ground, either above sandy soil, flooded ground or above the flowing Río Bermejo (15 observations/6 individuals); making 0.5–1-m-long upward sally-strikes to feed on green Lepidoptera larvae (1.5 times the length and width of the bill) on palo flojo leaves at 5–6-m height (4/2); clinging to feed on ripe fruits of tala (*Celtis* cf. *ehrenbergiana*) in forest understory at 0.5–1 m (5/2), and clinging to feed on insects on leaves of garabato (*Acacia praecox*) (2/1) and sacha membrillo (*Capparicordis tweediana*) at 3–4 m (2/1).

Vocalizations

Although we spent several dawns in *Tessaria* vegetation, we were unable to detect any dawn song or dawn singing peak. Instead, birds vocalized more often after 0600 hrs and regularly up to 1000 hrs Argentina Time (ART). The most commonly heard call without playback elicitation was the *pit* (>65 records), followed by the *fee-bee-o* song (9 records) and other calls (>2 records). In

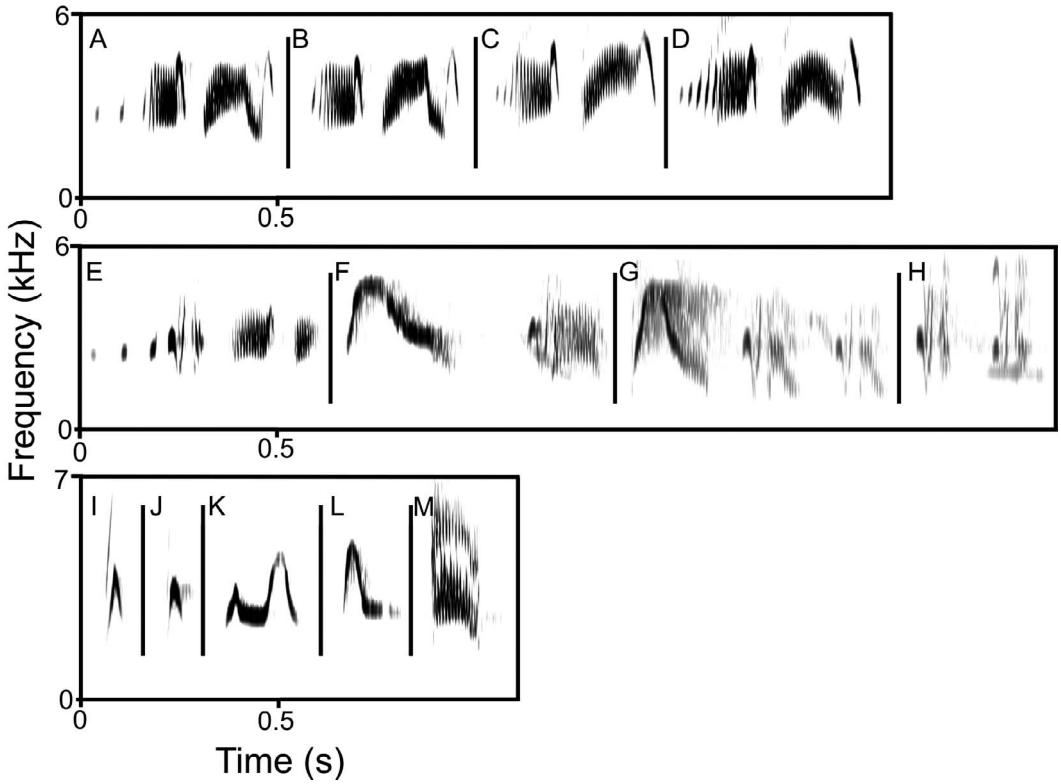

FIG. 2. Vocalizations of Alder Flycatchers (*Empidonax alnorum*) overwintering in northern Argentina. Unless otherwise noted, vocalizations were made in response to playback. (A–C) *fee-bee-o*, Reserva Natural Formosa, Formosa, 21 November 2014, 21 November 2014, and 10 December 2013, respectively. (D) *fee-bee-o*, El Talar, Jujuy, 20 November 2014. (E) complex *churrs* resembling song, RN Formosa, 21 November 2014. (F–G) *wee-oo* and single *churr,* and *wee-oo* and double *churr,* 21 November 2014, RN Formosa. (H) double *churr,* 21 November 2014, RN Formosa. (I) *pit*, 10 December 2013, RN Formosa. (J) *pit*, unsolicited, El Talar, Jujuy, 20 November 2014. (K) Double-peak note, 21 November 2014, RN Formosa. (L) *wee*, unsolicited, 16 March 2014, RN Formosa. (M) *peeerr*, 10 December 2013, RN Formosa. All recordings by J. I. Areta. See methods for spectrogram parameters.

response to playback, birds tended to perch hidden on small lateral branches near the top of 3–6-m-tall *Tessaria integrifolia* or 2–3-m-tall *Baccharis salicifolia* shrubs to vocalize, rarely singing or calling when exposed. Most birds responded to playbacks by giving the *pit* call. When we were outside the territory, birds responded only by calling. Responses to playbacks from within their territories varied greatly; they completely ignored the playback, just gave the *pit* call, or approached and flew over the speaker with a raised crest while singing or giving a large variety of aggressive calls.

'Fee-bee-o' Song.—We recorded five singing individuals, four in response to playback and one singing naturally. This vocalization differed markedly between individuals (Fig. 2A–D). Birds threw their heads back while singing, and their tails quivered. A complex churring sound with a long introduction and ending similar to a song was recorded once during an aggressive display (Fig. 2E).

'Zwee-oo' Call.—We occasionally heard this call during the birds' aggressive interactions but never recorded it (few records).

'Wee-oo' Call.—We frequently heard this call during territorial encounters. The conventional *wee-oo* (Fig. 2F, G, first note) was sometimes modified to a simple *wee*, lacking the raspy descending portion (Fig. 2L).

'Churr' Call.—This call was given frequently after the *wee-oo* call, either once or in couplets. We

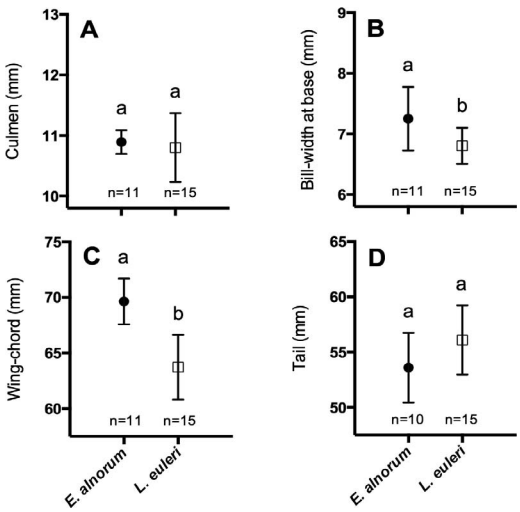

FIG. 3. Morphological comparison of Alder Flycatchers (*Empidonax alnorum*) and Euler's Flycatchers (*Lathrotriccus euleri*) in Argentina. (A) Culmen, (B) bill-width at base, (C) wing-chord, and (D) tail. All measurements in millimeters. Bill-width at base and wing-chord were statistically different between species for two-tailed Mann-Whitney *U*-tests ($P < 0.01$; see Appendices S1 and S3 for data).

recorded two different pitched versions of this call (Fig. 2F, G, second segment, and 2H; numerous records). A harsh *peeerr* may constitute a variation of the second part of the *churr* (Fig. 2M).

'Pit' Call.—Birds made this call in bouts of 2–3 mins and then were silent for periods of undetermined length. Generally, one bird would start calling, and 1–5 neighboring individuals would answer. The call was given frequently while foraging, and its emission rate increased during aggressive encounters and in response to playback. Calls varied from sharply peaked to arched (Fig. 2I, J). The *pit* call was heard throughout the day, even in moments of extreme heat between 1200–1700 hrs, when bird activity is almost nil during summer. The stands of *Tessaria* seemed to be cooler than the dry forest, which may have facilitated this extended activity. From a local perspective, the *pit* call resembles the *pk* of Small-billed Elaenia (*Elaenia parvirostris*), which is lower pitched and not metallic, and superficially similar to some variations of the *tek* call of Pearly-bellied Tody-tyrant (*Hemitriccus margaritaceiventer*) which is even deeper-toned and more staccato.

Double-Peak Call.—We heard this quickly double-inflected whistle during the birds' aggressive interactions in response to playback (Fig. 2K; numerous records) interspersed with other calls.

'Kitter' Call.—This call is a soft metallic clicking or trill consisting of a long series of brief notes of variable pitch, shape, and tempo given in quick succession. It is given at the peak of excitement in response to playback. We did not record it in our study site (5 records), but see ML 7552 (macaulaylibrary.org/audio/7552), which begins with this clicking. The call is similar to, but faster and higher-pitched than, a clicking call by Slaty Elaenia (*Elaenia strepera*).

Morphological Measurements and Molt

We documented molting individuals from January through March (Appendix S2). Alder Flycatchers collected in Argentina had significantly longer wings and wider bills than specimens from the sympatric Euler's Flycatchers from Argentina (Fig. 3, Appendix S3). Since we had few specimens at hand, we did not attempt to analyze data partitioned by sex. The longer wings and the shorter tail (nonstatistically different) of Alder Flycatchers, should result in a proportionally longer-winged profile (i.e., with wings overlapping proportionally more of the total length of the tail). Likewise, the wider but similarly long bill of Alder Flycatchers, results in a more boat-billed appearance than in Euler's Flycatcher.

DISCUSSION

Our records indicate that large numbers of Alder Flycatchers overwinter along rivers crossing the Chaco region and in the foothill forests of the Yungas of Argentina, and that the species' southern wintering range is significantly larger than hitherto thought (Fig. 1). Four specimens collected by W. H. Partridge at km 10 of Arroyo Urugua-í in NW Misiones, Argentina, appear to be the only records of the species in the Atlantic Forest (Navas and Bó 1988). Despite extensive work in the Atlantic Forest of Argentina, including along the Ríos Paraná and Iguazú and the Arroyo Urugua-í, we have never detected Alder Flycatchers there. We speculate that these records might have been related to the existence of a habitat type (perhaps stands of *Tessaria*) now lost because of

flooding of this watercourse by the Urugua-í dam. A few documented records of Alder Flycatchers in Brazil (Stotz et al. 1992, de Vasconcelos et al. 2008, Lees et al. 2013), Bolivia (Parker et al. 1993, Jahn et al. 2002), and Paraguay (Zyskowski et al. 2003) exist, but no Paraguayan records have been confirmed through vocalizations (R. Clay, pers. comm.). It seems incredible that with a global population estimate of ~50 million individuals of this species (Rich et al. 2004, Gómez and Bayly 2011), all of which are thought to overwinter in South America, so few records for the continent exist.

Since the austral distribution of Alder Flycatchers seems to be tied to the distribution of stands of *Tessaria integrifolia*, it is crucial to understand the distribution of the latter. The very sinuous Río Bermejo has large shallow areas known as 'espolones' (spikes) created by sedimentation on alternating sides of its meandering course. Here, large forest masses of *Tessaria* grow throughout the river course and form the bulk of this vegetation in the Río de La Plata basin (Reboratti and Neiff 1987; JIA et al., pers. obs.). These spikes are important for overwintering Alder Flycatchers and harbor sizeable numbers of them during the Austral spring and summer. The Río Pilcomayo has significant stands of *Tessaria* only on its upper portion, few or none in the middle portion, and a few small patches on its lower portion. Along the lower Río Paraná and the Río Paraguay, *Tessaria* forms thin, long, linear patches on islands and on both shores symmetrically (Reboratti and Neiff 1987). We suspect that Alder Flycatchers may occur on the lower Paraná in the provinces of Chaco, Corrientes, and Santa Fe. We conclude that the Bermejo and its tributaries are more important for overwintering Alder Flycatchers than the Pilcomayo and Paraná/Paraguay rivers in direct relationship to the extent of cover of *Tessaria*. Future surveys along these rivers should help test this proposition.

Our data provide the first estimate of overwintering times for Alder Flycatchers at any location in South America. Birds arrive near mid-November and depart near mid-March, spending ~4 months in the southernmost portion of their wintering distribution. Being in the south, these data are consistent with southbound passage in Sarteneja, Belize (mid-Sept to early-Oct; Gómez and Bayly 2011), Sasardi, Colombia (late-Sept to mid-Oct; Colorado 2010), arrival at Cocha Cashu, Peru (16–19 Oct; Foster 2007), and departure from San Julián, Bolivia (9 Apr; Jahn et al. 2002). Although Foster (2007) postulated that waves of individuals recorded in Peru up to 11 November could be floaters or newly arrived migrants in Perú, the timing of these waves also suggests that they may have been southbound migrants and not birds trying to settle. A record from 7 Aug in southwest Peru at Rio Tambopata (Whitney and Kaufman 1986), may pertain to a late northbound migrant, a very early southbound migrant or an oversummering individual and does not seem representative of normal seasonality of the species.

It has been suggested that Alder Flycatchers may be present in riverine forests not because of any special ecological need, but rather because they might use the rivers as corridors during their migration (Jahn et al. 2002). Our data do not support this idea. Alder Flycatchers in the Chaco region were found to be territorial in stands of *Tessaria*, other riverine habitats, and riverine forests for long periods which indicate that they depend on resources present in these habitats for their survival. Likewise, Foster's (2007) and our data and the recapture of two individuals in two consecutive Austral summers in riverine forest (Jahn et al. 2002) support the ecological dependence of Alder Flycatchers on riparian habitats while overwintering in South America.

Camperi et al. (2013) reported *Empidonax alnorum argentinus* (a subspecies which does not exist) for the avifauna of Jujuy province, presumably an erroneous attribution of a subspecies of Euler's Flycatcher (*Lathrotriccus euleri argentinus*) to the Alder Flycatcher. The correct identification of museum specimens of Euler's and Alder flycatchers is neither trivial nor straightforward. We consider numerous specimens in Argentine museums that are identified as Alder Flycatchers to be Euler's Flycatchers (Appendix S1). Field identification of these flycatchers may also be difficult, especially because very worn adults (i.e., less olive dorsally) and young Alder Flycatchers can resemble Euler's Flycatchers in that both have buffy wing-bars (JIA, pers. obs.; see Ridgely and Tudor 1994 for further identification tips). Before the migration path of Alder Flycatchers can be understood, this identification challenge must be overcome.

The winter territory sizes that we estimated visually in this study are small and extremely similar to those reported by Foster (2007). We never detected 'territory associates,' and all birds we observed were solitary. However, territory associates may have been overlooked if not vocalizing regularly. Edges in stands of *Tessaria* and open canopied trees in riparian forests are important habitat features for Alder Flycatchers overwintering in northern Argentina. They provide ample spaces for aerial hawking, which was the dominant foraging mode during our study in Argentina and Foster's (2007) in Peru.

Alder Flycatchers spend at least one third of the year at their wintering grounds in northern Argentina. The geographical provenance of these individuals is not known. However, other widespread breeding Nearctic passerines overwintering in northern Argentina are known to come from eastern breeding populations (Ruegg and Smith 2002, Hobson et al. 2015). Vocal, isotopic, and genetic studies of overwintering Alder Flycatchers should help to elucidate the migratory provenance of the southernmost overwintering individuals.

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APPENDIX S1. Records of Alder Flycatchers (*Empidonax alnorum*) in Argentina, including comparative morphological data and re-identification of some Euler's Flycatchers (*Lathrotriccus euleri*). Numbers = previous confirmed specimen localities, letters = new confirmed records. See Fig. 1 for mapping of localities.

Museum/record	Number	Species	Subspecies	Reference in Figure 1	Locality	Province	Sex	Day	Month	Year	Collector/observer	Comments	Decimal degrees (South)	Decimal degrees (West)	Altitude	Culmen	Bill width at base	Wing-chord	Tail
FML	2199	*Empidonax alnorum*		1	Iquirá, Aguaray	Salta	F	23	2	1946	O Budin		22.300	63.767	720	10.77	7.34	71	NA
Record	–	*Empidonax alnorum*		a	Laguna del Palo Pique	Salta	?	12	11	2015	JIA, GM and EAD	Two individuals' sound recorded	23.049	64.300	320	NA	NA	NA	NA
?	?	*Empidonax alnorum*		2	Embarcación	Salta	?	?	?	?	?	Hellmayr (1927). No mention of date, specimen precedence, or collector.	23.217	64.138	290	NA	NA	NA	NA
Record	–	*Empidonax alnorum*		b	Puente Río Bermejo, 5 km S of Embarcacion	Salta	M	14	12	2013	JIA, GM and FAG	Heard calling naturally 'pit' and 'weerr' calls	23.249	64.138	290	NA	NA	NA	NA
Record	–	*Empidonax alnorum*		b	Puente Río Bermejo, 5 km S of Embarcacion	Salta	M	30	12	2013	D Almirón and H Hulsberg	Seen in response to playback	23.249	64.138	290	NA	NA	NA	NA
Record	–	*Empidonax alnorum*		c	Río Santa María	Salta	?	26	11	2014	DG	Mist-netted, weighed, measured, and photographed	23.265	64.479	420	See text	NA	See text	See text
MACN	30712	*Empidonax alnorum*		3	Alto Río Santa María	Salta	M	16	12	1947	A Giai	Camperi (1986, 1990)	23.309	64.681	420	10.63	7.39	70.5	57
MACN	30711	*Empidonax alnorum*		3	Alto Río Santa María	Salta	M	16	12	1947	A Giai	Camperi (1986, 1990)	23.309	64.681	420	11.03	7.07	69.5	58
FML	13880	*Empidonax alnorum*		4	El Talar	Jujuy	?	23	3	1965	A Contino	Correct name of locality is El Talar, not El Tolar as reported by Camperi (1986)	23.556	64.363	325	10.54	7.24	70.5	52.5
Record	–	*Empidonax alnorum*		d	Río San Francisco, 2 km W of El Talar	Jujuy	M	20	11	2014	JIA and EAJ	Sound recorded	23.565	64.383	325	NA	NA	NA	NA
Record	–	*Empidonax alnorum*		e	Puente Río San Francisco, 6 km NE of Caimancito	Jujuy	M	20	11	2014	JIA	Heard and seen in response to playback	23.712	64.536	350	NA	NA	NA	NA

APPENDIX S1. Continued.

Museum/record	Number	Species	Subspecies	Reference in Figure 1	Locality	Province	Sex	Day	Month	Year	Collector/observer	Comments	Decimal degrees (South)	Decimal degrees (West)	Altitude	Culmen	Bill width at base	Wing-chord	Tail
Record	–	*Empidonax alnorum*		f	Reserva Natural Formosa	Formosa	Presumably both	–	–	2013-2015	JIA, GM, FAG and EJ	Sound recorded, photographed, and filmed. Extreme dates: arrival 22 Nov; departure 17 Mar. See text for details.	24.312	61.815	170	NA	NA	NA	NA
MACN	38649	*Empidonax alnorum*		5	Arroyo Urugua-í, km 10	Misiones	F	6	3	1958	WH Partridge	Identification uncertain. Possibly a molting *Empidonax alnorum*, hence the short wings and tail.	25.900	54.600	225	11.09	6.88	64.5	51
MACN	38650	*Empidonax alnorum*		5	Arroyo Urugua-í, km 10	Misiones	M	9	3	1958	WH Partridge		25.900	54.600	225	10.85	6.98	69	52
MACN	39480	*Empidonax alnorum*		5	Arroyo Urugua-í, km 10	Misiones	M	19	11	1959	WH Partridge	Navas and Bó (1988)	25.900	54.600	225	10.98	6.58	70	51.5
MACN	39481	*Empidonax alnorum*		5	Arroyo Urugua-í, km 10	Misiones	M	19	11	1959	WH Partridge	Navas and Bó (1988)	25.900	54.600	225	11.17	7.19	73	58.5
MACN	39479	*Empidonax alnorum*		5	Arroyo Urugua-í, km 10	Misiones	M	3	11	1959	WH Partridge	Navas and Bó (1988)	25.900	54.600	225	10.99	7.45	70	49.5
Record	–	*Empidonax alnorum*		g	5 km NW of the mouth of the Río Bermejo	Formosa	M	13	1	2015	FG	Sound recorded and photographed	26.832	58.402	55	NA	NA	NA	NA
FML	15149	*Empidonax alnorum*		6	Laguna La Ripiera, San Felipe	Tucumán	M	19	12	1986	EA Alabarce and CD Laredo	Camperi (1986)	26.883	65.233	440	10.98	8.64	69	54
MACN	9647	*Empidonax alnorum*		7	Concepción	Tucumán	F	6	12	1917	J Mogensen	Camperi (1986)	27.333	63.583	400	10.79	7.01	69	52

APPENDIX S1. Continued.

Museum/record	Number	Species	Subspecies	Reference in Figure 1	Locality	Province	Sex	Day	Month	Year	Collector/observer	Comments	Decimal degrees (South)	Decimal degrees (West)	Altitude	Culmen	Bill width at base	Wing-chord	Tail
FML	14286	*Lathrotriccus euleri*	*argentinus*		Piquirenda Viejo	Salta	F	16	11	1984	CC Olrog, R Barquez and Guerrero	Erroneously reported as *Empidonax alnorum* by Camperi (1986). Better considered as an individual of *Lathrotriccus euleri* by measurements (particularly wing-chord), although resembling *E. alnorum* in bill-width. Dorsal color tends to be olivaceous as in FML15149, and also resembling it in having a brownish cap. Wing-bars are very cinnamon, like in several *L. euleri* examined and much rustier than in any *E. alnorum* individual.				10.93	7.44	61.5	52
FML	356	*Lathrotriccus euleri*	*argentinus*		Río Surutú	Santa Cruz, Bolivia		25	9	1917	J Steinbach					11.73	6.64	67	59.5

APPENDIX S1. Continued.

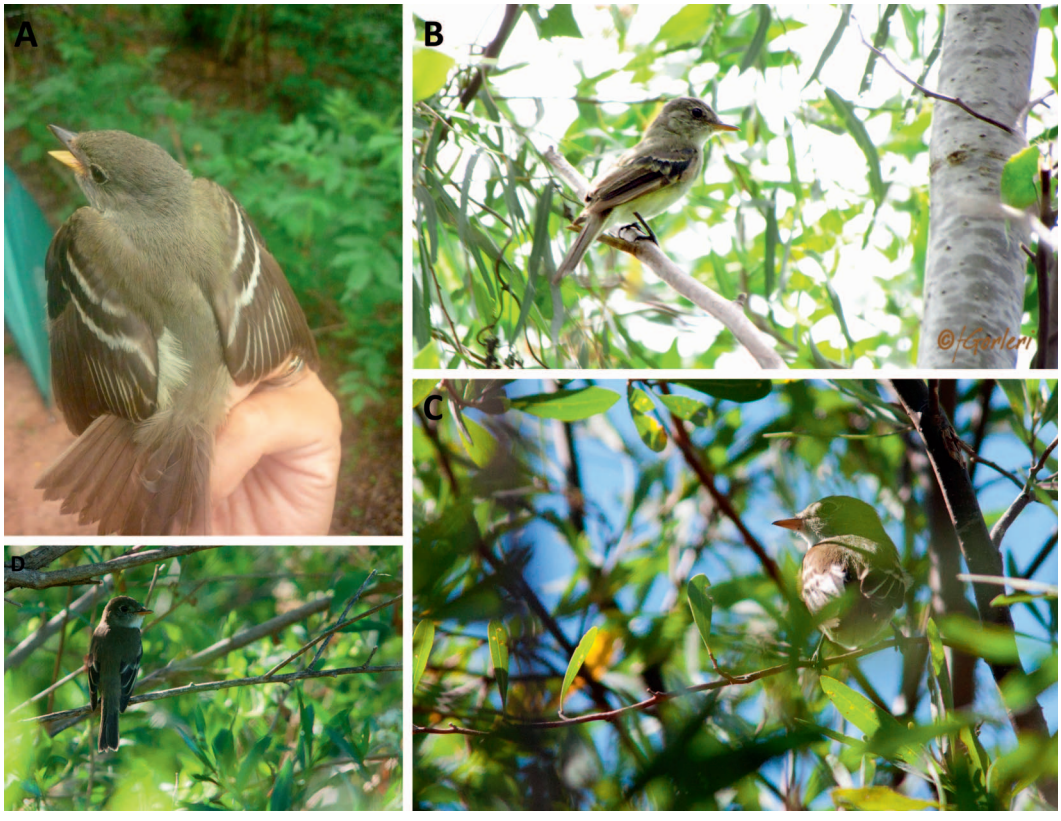
Museum/record	Number	Species	Subspecies	Reference in Figure 1	Locality	Province	Sex	Day	Month	Year	Collector/observer	Comments	Decimal degrees (South)	Decimal degrees (West)	Altitude	Culmen	Bill width at base	Wing-chord	Tail
FML	2191	*Lathrotriccus euleri*	*argentinus*		Iquirá, Aguaray	Salta		23	2	1946	O Budin	An interesting specimen, collected in the same site and date as one of the specimens of *Empidonax alnorum*.				10.34	7.2	64	57.5
FML	946	*Lathrotriccus euleri*	*argentinus*		Timbó Viejo, Burruyacu	Tucumán		17	9	1946	JG Esteban					10.74	6.64	64	60
MLP	12244	*Lathrotriccus euleri*	*argentinus*		Santa Barbara	Jujuy	M	23	11	1966	A Contino					9.84	6.45	66	57.5
MACN	34397	*Lathrotriccus euleri*	*euleri*		Tobunas	Misiones	F	19	9	1953	WH Partridge	Previously identified as *Empidonax alnorum* in the collection. Here considered to be *Lathrotriccus euleri*.				10.4	6.93	63	55.5
MACN	36953	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í, km 30	Misiones	F	8	9	1954	WH Partridge	Previously identified as *Empidonax alnorum* in the collection. Here considered to be *Lathrotriccus euleri*. Many more specimens from this locality have been misidentified as *E. alnorum*. This being just a sample of this error.				10.71	7.05	61.5	54

APPENDIX S1. Continued.

Museum/record	Number	Species	Subspecies	Reference in Figure 1	Locality	Province	Sex	Day	Month	Year	Collector/observer	Comments	Decimal degrees (South)	Decimal degrees (West)	Altitude	Culmen	Bill width at base	Wing-chord	Tail
MACN	38044	*Lathrotriccus euleri*	*euleri*		Rio Iguazu, km 60	Misiones	M	11	3	1951	WH Partridge	See comments under MACN34397.				NA	NA	NA	NA
MACN	38630	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í, km 30	Misiones	F	26	11	1957	WH Partridge	See comments under MACN36953.				NA	NA	NA	NA
MACN	36962	*Lathrotriccus euleri*	*euleri*		Refugio Piñalitos	Misiones	M	11	11	1954	WH Partridge	See comments under MACN34397.				NA	NA	NA	NA
MACN	38628	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í, km 30	Misiones	F	8	11	1957	WH Partridge	See comments under MACN36953.				NA	NA	NA	NA
MACN	38639	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í, km 30	Misiones	M	1	1	1957	WH Partridge	See comments under MACN36953.				NA	NA	NA	NA
MACN	38644	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í, km 30	Misiones	F	4	1	1958	WH Partridge	See comments under MACN36953.				NA	NA	NA	NA
MACN	38625	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í, km 30	Misiones	M	4	11	1957	WH Partridge	See comments under MACN36953.				NA	NA	NA	NA
MLP	13782	*Lathrotriccus euleri*	*euleri*		Tobunas	Misiones	M	1	9	1959	WH Partridge					10.17	6.8	65	56.5
MLP	11887	*Lathrotriccus euleri*	*euleri*		Eldorado km6	Misiones	F	21	3	1963	A Kovacks					11.28	6.61	59	51
MLP	12597	*Lathrotriccus euleri*	*euleri*		Tobunas	Misiones	M	28	9	1943	WH Partridge					10.94	7.04	65	57
MLP	13781	*Lathrotriccus euleri*	*euleri*		Tobunas	Misiones	F	1	9	1959	WH Partridge					11.84	6.55	68	61
MLP	11982	*Lathrotriccus euleri*	*euleri*		Eldorado km11	Misiones	F	15	9	1961	A Kovacks					11.41	6.43	61	51.5
MLP	13897	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í km30	Misiones	M	23	10	1957	WH Partridge	Specimen label has *Empidonax alnorum* written in pencil and crossed out.				10.58	6.58	68	59
MLP	13898	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í km 30	Misiones	F	10	1	1958	WH Partridge	See comments under MACN36953.				10.32	7.06	59	54
MLP	13953	*Lathrotriccus euleri*	*euleri*		Arroyo Urugua-í km 30	Misiones	M	9	2	1951	WH Partridge	See comments under MACN36953.				10.79	6.65	64	55.5

APPENDIX S2

Photographs showing molt in live Alder Flycatchers (*Empidonax alnorum*) overwintering in northern Argentina. A) Río Santa María, Salta, 26 November 2014. Photograph: Daniela Gómez, B) 5 km west of mouth of Río Bermejo, Formosa, 13 January 2015. Photograph: Fabricio C. Gorleri, C) Reserva Natural Formosa, Formosa, 4 February 2015, Photograph: Juan I. Areta, and D) RN Formosa, 3 March 2015, Photograph: Juan I. Areta. The single mist-netted bird (A) showed no sign of molt and had only minor wear (Appendix S2). It weighed 11 g and measured: wing-chord 71 mm, tarsus 18.7 mm, exposed culmen 81 mm, and tail 63 mm. One individual (B) had a new tail, a new lower wing-bar (upper greater secondary wing-coverts) and a worn upper one (upper medium secondary wing-coverts), very worn tertiaries, new secondaries, and very worn primaries, with a gap between primaries and secondaries because of molt of an unknown number of inner primaries. A second bird (C) had virtually no tail (indicating strong molt), new wing-bars, tertiaries, and secondaries, and much worn primaries, with perhaps the inner primaries being molted. A third bird (D) showed a slightly worn tail and new wing-bars, tertiaries, secondaries, and primaries (Appendix S2). Both wings exhibited the same molt pattern in all feathers in all birds. All molting birds were photographed and identified by song.



APPENDIX S3. Morphological comparison of Alder Flycatchers (*Empidonax alnorum*) and Euler's Flycatchers (*Lathrotriccus euleri*) in Argentina. *P*-values are for two-tailed Mann-Whitney *U*-tests. Numbers in columns are means ± standard deviation, range is given in brackets, and sample size is denoted in parentheses.

	Alder Flycatcher	Euler's Flycatcher
Culmen ($P > 0.31$)	10.89 ± 0.19 [10.54–11.17](11)	10.80 ± 0.57 [9.84–11.84](15)
Bill-width at base ($P = 0.01$)	7.25 ± 0.52 [6.58–8.64](11)	6.80 ± 0.30 [6.43–7.44](15)
Wing-chord ($P < 0.01$)	69.64 ± 2.06 [64.5–73](11)	63.73 ± 2.91 [59–68](15)
Tail ($P = 0.09$)	53.60 ± 3.15 [49.5–58.5](10)	56.10 ± 3.14 [51–61](15)