



BEAK DEFORMITIES IN NORTH PATAGONIAN BIRDS

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Abstract · Within the last decade, many individuals of several bird species with abnormal and strange beaks deformations have been reported from Alaska, United States, and from United Kingdom and Ireland. Different forms of beak deformities were observed, but the causes of these abnormalities are unknown. We report beak deformities in two species of birds in northwestern Patagonia, Argentina: Austral Thrush (*Turdus falcklandii*) and Patagonian Mockingbird (*Mimus patagonicus*). Between 2013 and 2016, we captured individuals of White-crested Elaenia (*Elaenia albiceps*, N = 305), Rufous-collared Sparrow (*Zonotrichia capensis*, N = 119), Austral Thrush (N = 100), Black-chinned Siskin (*Spinus barbata*, N = 64), Patagonian Sierra-Finch (*Phrygilus patagonicus*, N = 48) and Gray-hooded Sierra-Finch (*Phrygilus gayi*, N = 40) in surroundings of Esquel city, located in western Patagonia, Chubut province, and quantified the prevalence of beak deformities. Only adult Austral Thrushes (5 out of 78; 6.41%) showed abnormal beaks. Neither juvenile thrushes (N = 22) nor the other five species showed beak deformations. Austral Thrushes with beak deformations were also observed and photographed (but not captured) in other areas around the city. We also photographed one Patagonian Mockingbird with an abnormal beak near Las Plumas Village, Chubut province. Beak deformities varied from light to severe, and also in their form. Most of them were characterized by an elongated and often decurved upper mandible, producing an overbite; in other individuals both mandibles were elongated and sometimes crossed or had a pronounced gap. Most affected birds showed signs of improper preening, and one of them was malnourished. All of these characteristics are similar to those described for birds affected by avian keratin disorder in North America. Further research is needed to detect potential presence of other species with beak deformities in Patagonia, to find out possible causes of such deformities, and to determine whether these anomalies are associated with natural habitats or urban environments.

Resumen · Deformidades del pico en aves del norte de Patagonia

En la última década se ha informado acerca de individuos de varias especies de aves con picos anormales y extraños en Alaska, Estados Unidos, y en Reino Unido e Irlanda. Se observaron diferentes formas de deformidades del pico, pero las causas de estas anomalías no se conocen. Reportamos la presencia de dos especies de aves con pico deformado en el noroeste de la Patagonia en Argentina: el Zorzal Patagónico (*Turdus falcklandii*) y la Calandria Mora (*Mimus patagonicus*). Entre 2013 y 2016 capturamos individuos de Fiofio Silbón (*Elaenia albiceps*, N = 305), Chingolo (*Zonotrichia capensis*, N = 119), Zorzal Patagónico (N = 100), Cabecita Negra Austral (*Spinus barbata*, N = 64), Comesebo Patagónico (*Phrygilus patagonicus*, N = 48) y Comesebo Andino (*Phrygilus gayi*, N = 40) en los alrededores de la ciudad de Esquel, oeste de Patagonia, provincia del Chubut, y cuantificamos la prevalencia de las deformaciones. Solo los zorzales adultos (5 de 78, 6,41%) mostraron picos anormales. Ni los zorzales juveniles (N = 22) ni las otras cinco especies mostraron deformaciones del pico. También se observaron y fotografiaron (pero no se capturaron) zorzales con deformaciones del pico en otras áreas alrededor de la ciudad. Además fotografiamos una Calandria Mora con pico deformado en los alrededores de Las Plumas, provincia del Chubut. Las deformidades del pico variaron en severidad y en forma. La mayoría estaba caracterizada por un pico alargado y una mandíbula superior curvada hacia abajo, produciendo una sobremordida. En otros individuos ambas mandíbulas estaban alargadas y a veces cruzadas o con un espacio importante entre ellas. La mayoría de las aves afectadas mostraron deficiencias en el acicalado de las plumas y una de ellas estaba desnutrida. Todas estas características son similares a las descritas para las aves afectadas por el desorden de queratina aviar en Norte América. Los trabajos futuros deberían evaluar la presencia de otras

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especies con pico deformado en la Patagonia, determinar la causa de las deformidades y estudiar si podrían estar asociadas al ambiente rural o urbano.

Key words: Argentina · Austral Thrush · Beak morphology · Patagonian forest · Patagonian Mockingbird · Patagonian steppe

INTRODUCTION

Within the last decade, beak deformities have been reported for several bird species in the Northern Hemisphere. Large clusters have been documented in North America, affecting 30 species in Alaska and 22 species in the Pacific Northwest (Van Hemert 2007, Handel et al. 2010), and in Europe, affecting 32 species in United Kingdom and Ireland (Harrison 2011). Although beak deformities are usually detected in a low proportion (< 1%) of a given population of wild birds (Handel et al. 2010 and references therein), an unusually high prevalence has been found among Black-capped Chickadees (*Poecile atricapillus*; 6.5% of adults) and Northwestern Crows (*Corvus caurinus*; 16.9% of adults) in Alaska (Handel et al. 2010, Van Hemert & Handel 2010). In British and Irish backyards, the proportion of birds affected was highly variable among species, ranging from 2.4 to 67.2% (Harrison 2011).

The condition characterizing beak deformities in Alaskan birds has been termed “avian keratin disorder” (Handel et al. 2010) because the keratin layer overgrows, resulting in noticeably elongated, often crossed beaks. Absolute rates of beak growth in affected Black-capped Chickadees were 50 to 100% faster than in unaffected individuals, supporting the hypothesis that abnormally rapid epidermal keratin production, and not lack of wear, is the primary cause of these beak deformities (Van Hemert et al. 2012).

Deformed bills can take many forms: crossed mandibles, upper and/or lower mandibles curved downwards, upper and/or lower mandibles curved upwards, or elongated mandibles (in most cases curved downward as well) (Craves 1994). Beak deformities can threaten bird health by affecting feeding and preening (Van Hemert et al. 2012). The etiology of the beak deformities in the Alaskan and European clusters is unknown (Handel et al. 2010, Harrison 2011), but several possible causes have been found or suggested for other birds: trauma or improper wear of the rhamphotheca (Pomeroy 1962); bacterial, viral, fungal, or parasitic infections (Gartrell et al. 2003, Mans & Guzman 2007, Keymer 2008, Galligan & Kleindorfer 2009); liver disease (Lumeij 1994); diseases caused by toxins (Bassir & Adenkunle 1970); mutations due to radiation, extreme heat or neoplasms (West 1959, Møller et al. 2007, Owen et al. 2007); and nutritional deficiencies, mainly due to abnormal vitamin or calcium metabolism (Tangredi 2007). A new virus, named Poecivirus, has recently been discovered that appears to be related to beak deformities in Alaskan birds (Zylberberg et al. 2016).

This virus was detected in all Black-capped Chickadees, Northwestern Crows, and Red-breasted Nuthatches (*Sitta canadensis*) tested with beak deformities, but only in few control individuals (i.e., without evidence of avian keratin disorder, Zylberberg et al. 2016).

So far, a high prevalence of beak deformities has been reported only in Northern Hemisphere species. In the Southern Hemisphere, there are only records of isolated cases of wild birds with abnormally grown bills (Vidoz & Bielsa 1994, Oscar 2012, Bianchini & Arenas 2014, Quiroga et al. 2016). In this paper, we describe deformed beaks of two northern Patagonian birds: Austral Thrush (*Turdus falcklandii*) and Patagonian Mockingbird (*Mimus patagonicus*). In addition, we report the proportion of the population of Austral Thrush that is affected by this anomaly in the study site.

METHODS

We collected data at three study sites in Chubut province, Argentina: Cañadón Florido, a cattle ranch located 5 km southwest of Esquel city (42°55'S, 71°21'W, 617 m a.s.l.), yards of Buenos Aires neighborhood in Esquel city (42°54'S, 71°20'W, 574 m a.s.l.), and around Las Plumas village (43°43'S, 67°16'W, 170 m a.s.l.). Being in the rain shadow of the Andes, the three sites have a typically Mediterranean climate, with dry summers. Mean annual precipitation drops dramatically from west to east; at Cañadón Florido and Esquel it is about 550 mm and in Las Plumas it only reaches 300 mm. Frost and dew are frequent throughout the year and more common during the fall and winter. The region is frequently swept by strong westerly winds. At Cañadón Florido, being part of the Subantarctic Biogeographical Province (Cabrera & Willink 1980), *Maytenus boaria* (Celastraceae), *Nothofagus antarctica* (Nothofagaceae), and *Schinus patagonicus* (Anacardiaceae) are the predominant woody species, and *Berberis microphylla* (Berberidaceae) prevails in the understory. Esquel yards are dominated by exotic ornamental plant species, such as *Cupressus macrocarpa* (Cupressaceae), *Ligustrum sinense* (Oleaceae), *Cytisus scoparius* (Fabaceae), *Rosa* sp. (Rosaceae), and *Pyracantha coccinea* (Rosaceae) (Rovere et al. 2013). Las Plumas village, located 340 km east of Esquel, is within the Patagonian Biogeographical Province (Cabrera & Willink 1980). The shrubby steppe vegetation is characterized by *Chuquiraga avellaneda* (Asteraceae), *Lycium ameghinoi* (Solanaceae), *Verbena ligustrina* (Verbenaceae), and *Prosopis denudans* (Fabaceae) (León et al. 1998).

Table 1. Total number and proportion of adult/juvenile and normal/abnormal beak individuals of the most abundant bird species captured at Cañadón Florido ranch, Esquel, Chubut, Argentina, during the three sampling periods (December 2013–January 2014, October 2014–March 2015 and October 2015–June 2016).

Species	N	Age		Abnormal beak (%)	
		Juveniles	Adults	Juveniles	Adults
White-crested Elaenia (<i>Elaenia albiceps</i>)	305	89	216	0	0
Rufous-collared Sparrow (<i>Zonotrichia capensis</i>)	119	6	113	0	0
Austral Thrush (<i>Turdus falcklandii</i>)	100	22	78	0	6.41
Black-chinned Siskin (<i>Spinus barbata</i>)	64	3	61	0	0
Patagonian Sierra-Finch (<i>Phrygilus patagonicus</i>)	48	0	48	0	0
Gray-hooded Sierra-Finch (<i>Phrygilus gayi</i>)	40	0	40	0	0

At Cañadón Florido ranch, we caught birds with mist nets within a 20-ha plot at the beginning of the Austral summer (December 2013–January 2014), during a spring and summer season (October 2014–March 2015), and during a spring, summer and fall period (October 2015–June 2016). We set 10 nets, 70 to 100 m apart, within the plot. Nets were 12 m long with 38 mm mesh size. Nets were opened for 4–5 h after sunrise during one or two days, every 10 or 15 days. We banded all birds with aluminum leg bands and took five morphological measurements: body mass, wing length, tail length, tarsus length, and bill length (from the anterior end of the nostril to the bill tip). We used a digital scale (± 0.1 g) to record body mass, a wing ruler (± 1 mm) for wing and tail measurements, and a digital caliper (± 0.01 mm) for tarsus and bill measurements. We also assessed other standard information of each bird, such as age (i.e., adults or juveniles, which were differentiated by the characteristics of the plumage, Canevari et al. 1992), fat storage (i.e., quantity of fat accumulated in the furculum and abdomen), molt status (i.e., intensity of body molt, and molting of wing and tail feathers), wing plumage wear (i.e., whether there was abrasion in primary and secondary flight feathers and whether tips of the feathers were broken), and breeding status (i.e., size of cloacal protuberance and brood patch development), following recommendations by Ralph et al. (1996). In Esquel city, between 2012 and 2016, we opportunistically observed birds in yards of Buenos Aires neighborhood. On the outskirts of Las Plumas village, we carried out occasional observations during December 2015. We photographed observed birds with beak deformities. We used those pictures to determine if there were different individuals with beak deformities in the area.

RESULTS AND DISCUSSION

At Cañadón Florido ranch, we captured 927 birds of 28 different species during 1993 net-hours throughout the three sampling periods. The most abundant species, in decreasing order, were White-crested

Elaenia (*Elaenia albiceps*), Rufous-collared Sparrow (*Zonotrichia capensis*), Austral Thrush (*Turdus falcklandii*), Black-chinned Siskin (*Spinus barbata*), Patagonian Sierra-Finch (*Phrygilus patagonicus*), and Gray-hooded Sierra-Finch (*Phrygilus gayi*) (Table 1). We observed obvious beak deformities in five adult Austral Thrushes, all captured towards the end of the last sampling period (i.e., fall 2016). This constituted 6.41% of all adult thrushes captured throughout the three sampling periods ($n = 78$ individuals). We also captured and examined 22 juvenile thrushes and none of them had beak abnormalities. We recaptured seven adults during the three sampling periods; all of them had normal beaks.

The normal beak of an Austral Thrush has the upper mandible as long as the lower mandible (Figure 1A). We refer to the five abnormal Austral Thrushes captured in Cañadón Florido by their numbered aluminum leg bands. Both thrush H000956 (Figure 1B) and thrush H000959 (Figure 1C) had a deformed beak with an overbite of 4.1 and 3.4 mm, respectively, with the upper mandible curved slightly downward. Thrush H000965 showed an elongation of both the upper and lower mandibles and its upper mandible was slightly decurved (Figure 1D). Thrush H000948 had a long beak in which the mandibles were slightly crossed, the upper mandible was decurved, and the lower mandible was upcurved, resulting in a pronounced gap between them (Figure 1H). Thrush H000963 (not photographed) had a long beak, with a straight lower mandible and a decurved upper mandible with the tip broken; mandibles were also slightly crossed at the tip. Thrushes H000963 and H000965 showed a 63% (10.4 mm) and 65% (10.7 mm) longer beak than average, respectively, but beak length of the other individuals fell within the range for birds in which the tips of the mandibles met normally (Table 2). The other body characteristics, the length of the wing, tail and tarsus of Austral Thrushes with beak deformities, all fell within the range of measurements for individuals with normal beaks (Table 2). One of the birds with a deformed beak, Thrush H000963, was 25% (20.2 g) lighter than the average mass of thrushes with normal beaks (Table

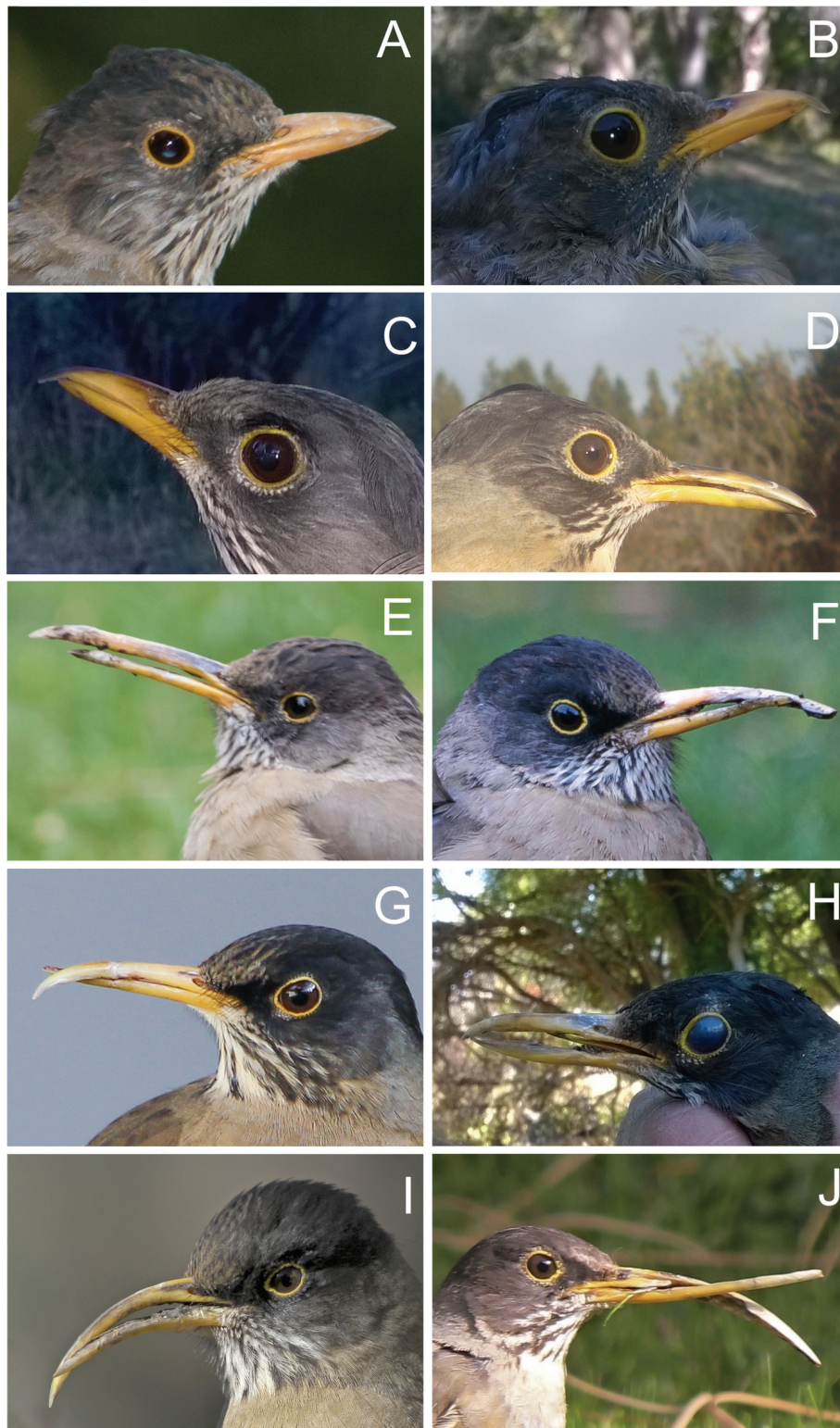


Figure 1. Austral Thrushes (*Turdus falcklandii*) showing different types of beak deformities of individuals captured or observed at Cañadón Florido ranch and Esquel city, Chubut, Argentina, from 2012–2016. A) Normal, B) H000956, C) H000959, D) H000965, E) Thrush 1, F) Thrush 2, G) Thrush 3, H) H000948, I) Thrush 4, J) Thrush 5. Individuals A, E, F, G, I, and J photographed in Esquel city (photos by Héctor Gonda), and B, C, D, and H captured at Cañadón Florido ranch (photos by Cristian Gorosito).

2), and it also had a concave breast and abdomen, which are signs of malnourishment.

Five adult Austral Thrushes with beak deformities were photographed between 2012 and 2016 in

Esquel yards. Their beak deformities were much more dramatic than those found at Cañadón Florido ranch; their mandibles were longer and more curved. Because we did not capture nor band Austral

Table 2. Five morphometric characteristics of adult Austral Thrushes (*Turdus falcklandii*) captured at Cañadón Florido ranch, Esquel, Chubut, Argentina, during the three sampling periods (December 2013-January 2014, October 2014-March 2015 and October 2015-June 2016). Sample size (N), mean and standard deviation (SD), minimum and maximum values of measurements taken on 45 of the 78 adults with normal beaks, and measurements taken on four birds with abnormal beaks are included. The number of each individual with a beak deformity corresponds to the numbered aluminum leg band for each bird. Measurements of thrush H000948 were not taken.

Measurements	Birds with normal beaks				Birds with abnormal beaks			
	Mean \pm SD	N	Min	Max	H000956	H000959	H000963	H000965
Wing length (mm)	124.9 \pm 4.4	45	113	137	132	128	123	128
Tail length (mm)	91.3 \pm 7.2	44	76	117	98	92	92	93
Tarsus length (mm)	41.7 \pm 1.7	45	38.3	44.5	40.2	41.7	39.1	40
Body mass (g)	82.0 \pm 6.6	45	68.6	100.2	90.4	87.2	61.8	83.8
Beak length (mm)	16.5 \pm 1.9	45	13.8	18.7	18.5	16.6	26.9	27.2

Thrushes in Esquel yards, we refer to them by increasing numbers from the least deformed beak to the most deformed one (i.e., from Thrush 1 to Thrush 5). Thrush 1 showed a beak twice as long as normal, with both mandibles straight and the tip of the upper one bending downward (Figure 1E). Thrush 2 (Figure 1F) and Thrush 3 (Figure 1G) both had long beaks, with a straight lower mandible, a decurved upper mandible, and fracture marks on the tips, which were also slightly crossed. Thrush 4 had a beak ca. 50% longer than normal, with both mandibles bent downward (Figure 1I). Thrush 5 had a beak three times longer than normal; the mandibles crossed each other half the way to the tip (Figure 1J). All of these birds were photographed in the fall and showed several wrongly aligned feathers in different parts of their bodies (e.g., in abdomen, sides and back), which is a sign of improper preening.

Around Las Plumas village, we photographed one Patagonian Mockingbird with a deformed beak in December 2015. It presented a beak twice as long as the average size and a twisted lower mandible with a thickening towards the tip; the condition of the plumage suggested some difficulty in preening, because the barbs of body feathers were far apart from each another and barbules were in disarray (Figure 2).

Since Austral Thrushes with beak deformities were caught only during the fall, this could indicate an association with the onset of cold weather in the region. We registered beak deformities only in adult birds, as found in Black-capped Chickadees in Alaska (Handel et al. 2010). In this species, several individuals that had had normal beaks when first captured were recaptured with beak deformities, suggesting that the beak deformity was either a condition acquired during adulthood or represented a delayed expression of a congenital condition (Handel et al. 2010). The proportion of adult Austral Thrushes with deformed beaks (6.41%) is similar to that in Black-capped Chickadees (6.5%) (Handel et al. 2010), and some bird species in British and Irish yards also showed a similar proportion of individuals with beak deformities (Harrison 2011).

Similar to chickadees and crows with avian keratin disorder (Handel et al. 2010, Van Hemert & Handel 2010), beak deformities ranged from small to extreme in size and shape (Figures 1 and 2), but other body characteristics were normal, except for some signs of improper preening. Preening helps maintain the plumage in good condition by dislodging and removing dirt particles and ectoparasites, such as mites and lice that feed directly on feathers, and ticks and fleas that feed on the birds themselves (Scott 2010). Only one of the Austral Thrushes with a deformed beak was 25% lighter than individuals with normal beaks (Table 2); this individual also had many lice (not taxonomically determined) and had difficulty to fly (it largely moved by hopping on the ground), probably due to its poor body condition.

Austral Thrushes with beak deformities have also been observed in other neighborhoods of Esquel (e.g., San Martín and Villa Ayelén neighborhoods, Susana Bravo pers. comm.), in San Carlos de Bariloche city, located 300 km north of Esquel (Vidoz & Bielsa 1994, Guillermo Amico pers. comm.), and in Trelew city, located 500 km east of Esquel (Oscar 2012). Other bird species with beak deformities have been observed in other regions of the country, such as Chalk-browed Mockingbird (*Mimus saturninus*) near Bahía Blanca, Buenos Aires province (Kaspar Delhey pers. com.), and Patagonian Mockingbird (*Mimus patagonicus*) in Ñacuñán Biosphere Reserve, Mendoza province (Taty Sagario & Javier Lopez de Casenave pers. comm.). Thus, the pattern of beak deformities that we have reported here is not a local problem. Further studies should be conducted in Patagonia to detect the potential presence of other species with beak deformities, to determine their geographic distribution, and to find out whether these anomalies are associated with natural habitats and/or urban environments.

Abnormal accelerated growth of the beak keratin layer observed in Black-capped Chickadees and other Alaskan birds (Handel et al. 2010) was recently found to be associated with a new virus, the Poecivirus (Zylberberg et al. 2016). Austral Thrushes and Patagonian

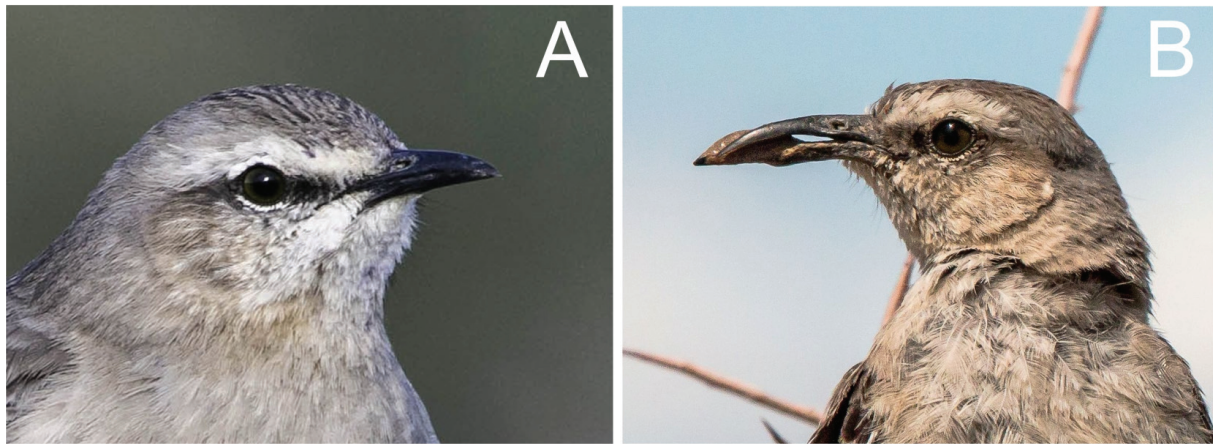


Figure 2. A Patagonian Mockingbird (*Mimus patagonicus*) with normal beak (left) and an individual with deformed beak (right) photographed near Las Plumas village, Chubut, Argentina, in December, 2015 (photos by Héctor Gonda).

Mockingbirds could be good candidates to evaluate whether or not the same virus is associated with avian keratin disorder in this part of the world, and to help generalize the potential role of Poecivirus in causing beak deformities.

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