

**Rapid Communication****Pet trade and the introduction of endemic species: the case of the Arabian Serin *Crithagra rothschildi* Ogilvie-Grant, 1902**Mohammed Alshamli<sup>1,2,\*</sup>, Mohammed Alzayer<sup>3</sup>, Luís Reino<sup>4</sup> and Faisal Hajwal<sup>5</sup><sup>1</sup>Biology Department, College of Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia<sup>2</sup>Ecology and Environmental Biology of Arabian Gulf and Desert Unit- Basic and Applied Scientific Research Center- Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia<sup>3</sup>Pathology Department – College of Veterinary Medicine, King Faisal University, Al-Ahsa, Saudi Arabia<sup>4</sup>CIBIO/InBIO, University of Porto, Capus Agrário de vairão, Vila do Conde, Portugal<sup>5</sup>Birds Monitoring Group – Dammam, Saudi ArabiaAuthor e-mails: [mmalshamli@iau.edu.sa](mailto:mmalshamli@iau.edu.sa) (MAIs), [malzayer@kfu.edu.sa](mailto:malzayer@kfu.edu.sa) (MAIz), [luis.reino@cibio.up.pt](mailto:luis.reino@cibio.up.pt) (LR), [Fahajwal@gsa.gov.sa](mailto:Fahajwal@gsa.gov.sa) (FH)

\*Corresponding author

**Citation:** Alshamli M, Alzayer M, Reino L, Hajwal F (2021) Pet trade and the introduction of endemic species: the case of the Arabian Serin *Crithagra rothschildi* Ogilvie-Grant, 1902. *BioInvasions Records* 10(2): 499–505, <https://doi.org/10.3391/bir.2021.10.2.27>

**Received:** 15 June 2020**Accepted:** 29 November 2020**Published:** 9 February 2021**Handling editor:** Thomas Evans**Thematic editor:** Angeliki Martinou**Copyright:** © Alshamli et al.

This is an open access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International - CC BY 4.0).

**OPEN ACCESS****Abstract**

Here we report the introduction and first observed breeding of the Arabian Serin *Crithagra rothschildi* in the eastern Arabian Peninsula. Although this species is the most widely distributed endemic bird in the western highlands of the Arabian Peninsula, this record represents a range expansion of approximately 1200 km beyond its established native range. Breeding was recorded twice, once in 2019 and once 2020, for two different pairs of birds. Early reporting of alien incursions is important, as combating biological invasions is most successful at the introduction stage. These records highlight the role of pet trade as a vector of alien species introductions. They also shed light on the impact that hunting, for the purpose of pet trade, exerts on birds in the western region of the Arabian Peninsula. We suggest that pet market monitoring may help to identify caged birds and prevent new introductions.

**Key words:** Saudi Arabia, wildlife trade, biological invasion, hunting, alien species, distribution**Introduction**

Biological invasions are considered one of the major drivers of environmental change globally (Blackburn et al. 2019; Pyšek et al. 2020). Novel fauna and flora that have been introduced intentionally or accidentally beyond their native range, and have then established and caused adverse impacts, are termed invasive species (Clavero et al. 2009; Courchamp et al. 2017). A multitude of invasive species are known for their severe adverse impacts, both ecologically and economically, in the invaded ecosystems (Lowe et al. 2000). Indeed, invasive species have been identified as one of the major causes of biodiversity loss, particularly by accelerating the extinction of endangered species (Blackburn et al. 2019). At a global scale, the pet trade has been identified as a major source of alien bird introductions; for example it is considered to be the primary driver of alien bird introductions in Latin America (Carpio et al. 2020). The identification of biological invasions at

an early stage increases the chances of successful alien species eradications that may protect native biodiversity (Dick et al. 2017). Here we document the first record of the Arabian Serin as an alien species on the Arabian Peninsula (located approximately 1200 km east of its native range). We are also the first to document successful breeding of the Arabian Serin as an alien species on the Arabian Peninsula.

The Arabian Serin, also known as the Olive-Rumped Seedeater, *Crithagra rothschildi* Ogilvie-Grant, 1902, is endemic to the western mountains of the Arabian Peninsula (Birdlife International 2018). The Arabian Serin tends to inhabit mountains at 1500–2500 metres above sea level (m.a.s.l), although it has been recorded at 700 m.a.s.l (Jennings 2010; Porter and Aspinall 2010). Its population spans the mountains of Saudi Arabia and Yemen, with approximately two-thirds of the population in Saudi Arabia (Jennings 2010). The population in Yemen is stable, whereas the population in Saudi Arabia is decreasing because of hunting pressure and the decline in Juniper (*Juniperus procera*) trees (Birdlife International 2018). The Arabian Serin is found in open areas with significant bush and tree cover and is commonly found on trees (Porter and Aspinall 2010). In Saudi Arabia, the Arabian Serin is associated with Juniper and Acacia (*Acacia* spp.) habitats, however, it is also recorded in habitats dominated by bushes. In the only study documenting its breeding, Castell et al. (2001) reported that all nests observed were found on Juniper trees. Nests were built against the main trunk or at the end of a branch with a clutch size of 2–3 eggs. Nestlings can be identified by the pattern in their mouth and the pink tongue with yellow gape flanges (Castell et al. 2001). The Arabian Serin frequently feeds on Acacia flowers, however, feeding on the ground and in bushes is not uncommon (Jennings 2010). In its native habitat, the Arabian Serin is non-gregarious at all seasons; groups do not exceed 10 birds.

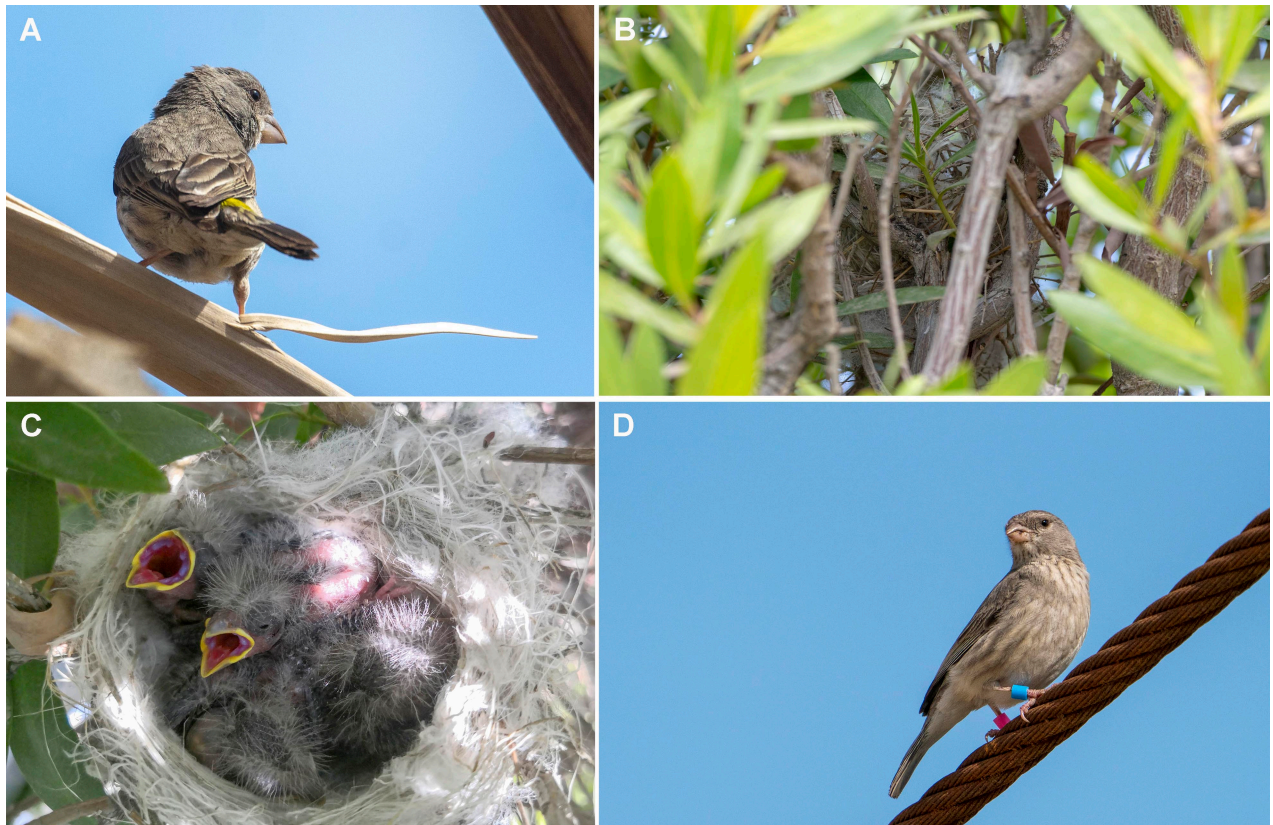
## Materials and methods

Observations reported in this paper are part of the seasonal activity of the Birds Monitoring Group (BMG) in the Eastern Province. BMG avifauna survey covers all major cities in the Eastern Province (Dammam, Qatif, Tarout, Khobar and Al-Hasa). The discovery of the first nest in 2019 was by Faisal Hajwal during one of the bird counts. Further monitoring was carried out in that year on a daily basis during the first hours of the morning until the nest was found empty. In 2020, the same area was surveyed for native and migrant birds, and a second pair of Arabian Serins were discovered on the same tree. Monitoring of this pair was carried out on a daily basis until the lockdown in March 2020 because of COVID-19.

## Results

### 2019 Nesting activity

In late January 2019, two individuals were observed on a Banyan tree, *Ficus benghalensis* (Figure 1A). They mainly fed on Banyan fruits (Table 1) and were

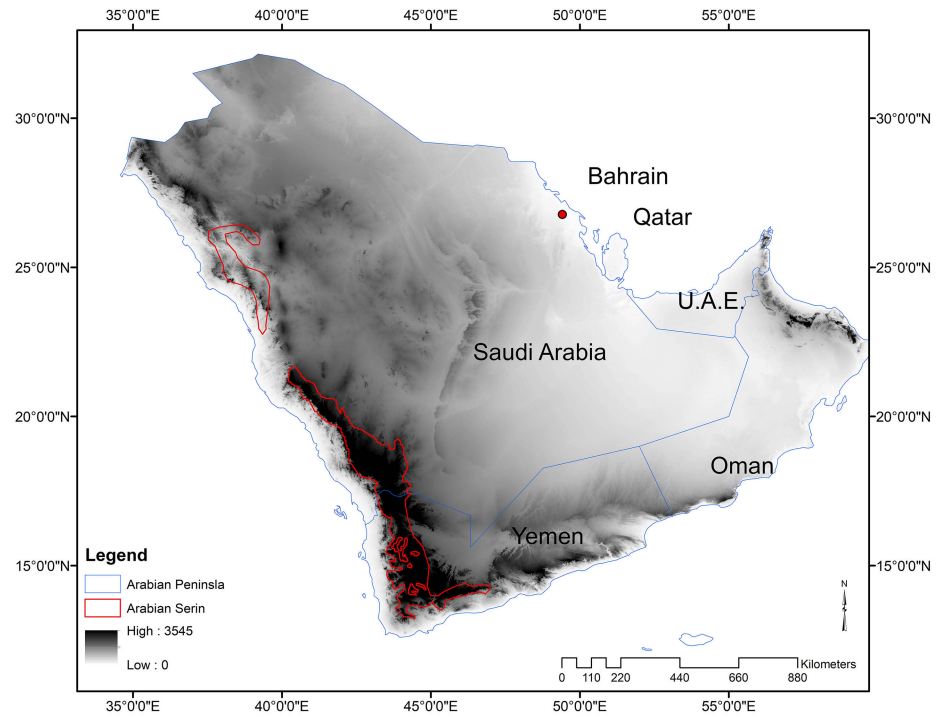


**Figure 1.** Pictures of Arabian Serin taken in 2019 and 2020 in Dammam. A) 2019 male, B) 2019 nest, C) 2019 nestlings, D) 2020 male. All pictures were taken by Faisal Hajwal.

**Table 1.** Plant species associated with *C. rothschildi* in Dammam.

Common name	Scientific name	Use
Damas	<i>Conocarpus lancifolius</i>	Nesting
Banyan	<i>Ficus benghalensis</i>	Feeding

frequently observed carrying nesting material to a nearby Damas tree, *Conocarpus lancifolius*. Upon closer investigation, the nest was located inside the tree, built at the base of several branches (Figure 1B). The condition of the nest indicated that the birds had been actively building it for over a week. The first egg was laid on 30 January, and the fourth egg on 3 February. Hatching was recorded on 16 February after a 14-day incubation period. In concordance with Castell et al. (2001), incubation was synchronised after the last egg was laid, although we recorded four eggs, whereas Castell reported three (Figure 1C). Furthermore, in its native range the Arabian Serin is known to have multiple broods (the earliest in March and the last in November). However, in its introduced range, the birds were recorded breeding in late January and early February. The last observation of the hatchlings in the nest was on 22 February. On 26 February, the nest was empty; we presumed that it had been predated, most likely by the Indian House Crow, *Corvus splendens*.



**Figure 2.** Arabian Peninsula map with elevation values, and the native distribution of the Arabian Serin, *Crithagra rothschildi*, based on Birdlife International (2018) shown in red. The red circle in the east represents the location of observed breeding.

### 2020 Nesting activity

In February 2020, we recorded the second breeding attempt in Dammam, on the same tree. However, these two birds were cage escapees as indicated by the plastic rings on their legs, which are used by pet traders (Figure 1D). As with the 2019 observations, both birds were actively building their nests in early February 2020. Further monitoring was prevented by the lockdown imposed due to the COVID-19 pandemic.

Breeding of the Arabian Serin beyond its native range has not previously been documented. However, sightings of the Arabian Serin have been reported in Riyadh (Jennings 2010). Interestingly, while collecting information from farm owners in Al-Qatif city (north of Dammam) on any unreported sightings of the Arabian Serin, the Bird Monitoring Group were informed of previous breeding attempts. Farmers and pet traders confirmed that the Arabian Serin has bred in the region on the same Damas plant in concordance with our observations.

### Discussion

The range of the Arabian Serin lies mainly in the mountainous ridge of the western Arabian Peninsula (Saudi Arabia and Yemen, Figure 2). This range is separated from the introduction site by vast stretches of barren desert (Figure 2). Arabian Serins are known to make limited localized movements; crossing 1200 km of desert (the natural expansion scenario) is highly unlikely (Porter 2014). Furthermore, the rings found on the 2020 pair (the

second breeding pair), are used strictly by pet traders in the region. These rings, and the large distance between the native range and the introduction site, provide clear evidence that the recorded birds were cage escapees. Thus, both pairs of the Arabian Serin described in this report are highly likely to have been introduced as a result of the pet trade.

The pet trade is one of the major drivers of invasive species introductions globally (Smith et al. 2009). Several traded birds, e.g. Ruppell's Weaver, *Polecus galbula*, Streaked Weaver, *Ploceus manyar* and Arabian Waxbill, *Estrilda rufibarba*, have been successfully introduced in the Arabian Peninsula (Symes et al. 2015; Jennings 2010; Alshamliah et al. 2020). Similar to the Arabian Serin, several of these birds are native residents of the Arabian Peninsula, with a limited distribution in the southwest region. They have been translocated by pet traders into new habitats, e.g. Ruppell's Weaver and Arabian Golden Sparrow (Jennings 2010, Alshamliah et al. 2020). Both species have been successfully established in Eastern Province, and Riyadh, respectively, with records of further introductions into neighbouring cities (Alshamliah et al. 2020). Despite the limited reporting of alien bird impacts in the region, few introductions have had a positive impact in the novel habitat globally (Gurevitch and Padilla 2004). The Arabian Serin might be the latest addition to the list of introduced species in the region with the potential to impact native birds and farm productivity. Thus, reporting new introductions such as the Arabian Serin, is important to enhance alien species management at its earliest stages and to protect wild populations.

In its native range, the Arabian Serin is often observed at 1500–2500 m.a.s.l within the mountain ridge of the western region. However, our records of the two nests in Dammam indicate its ability to successfully breed in novel coastal habitats at 5 m.a.s.l. (Figure 2). Additionally, in its native range, the Arabian Serin inhabits woodland and feeds on plant flowers (Jennings 2010). In both sightings reported in this study, nest building took place in an urban center of the city of Dammam with minimal tree cover used mainly for landscaping purposes (Figure 2). Based on these significant habitat differences, the observed breeding attempts suggest the Arabian Serin has significant potential to establish in its introduced range. It has been documented that captive-bred birds are poor invaders because of domestication effects compared to their wild counterparts (Carrete and Tella 2008). The successful nest building, egg laying and hatching that we have observed suggests a resilience and behavioural flexibility exhibited by wild-caught birds. As such we consider it is likely that both pairs documented in our study are wild-caught and were moved to Dammam for trading by pet traders.

These records highlight the impact that hunting for trading purposes has on wild birds, especially endemics. The overexploitation of wild populations for the purpose of supplying pet markets is a major threat to species survival (Maxwell et al. 2016). For example, many Brazilian birds are threatened

mainly because of hunting for trading in pet markets around the world (Alves et al. 2013). The tradition of keeping pet animals in the Arabian Peninsula is widely known, especially for exotics. Moreover, because there is a rooted tradition of keeping songbirds in cages, the pressure of illegally collecting such birds from the wild is ever increasing (Brochet et al. 2019). Globally, the Middle East is recognized as a major driver sustaining the wild bird market after Europe placed a ban on the trade of wild birds (Bush et al. 2014; Reino et al. 2017). Despite this global recognition, the local markets are not fully dependent on animals that originate abroad. Several native species were recorded in pet markets in Saudi Arabia, among which are wild-caught and endangered species (Shobrak and Al Fagih 2012; Aloufi and Eid 2014). Our records clearly indicate that the 2020 breeding pair were cage escapees given the observed colour rings on their legs (Figure 1C). The Arabian Serin is highly sought after in the market for its melodic song, often sold for about 30–100 USD a pair (personal comm. with pet traders). Hence, based on our discussions with pet traders in the area, the 2019 pair may have been re-captured along with their offspring and sold again in the market (despite our initial assessment of nest predation by Indian House Crow). Both the initial introduction and the probable recapture of the escapees reflect the demand for these birds. Although the Arabian Serin is declining in Saudi Arabia, primarily because of habitat degradation, the exhibited demand in the pet market for this bird would certainly jeopardize its recovery (Symes et al. 2015). Thus, to protect wild and endemic birds, pet markets need to be closely monitored to prevent the capture of wild birds.

In conclusion, the pet trade is a threat to wild populations and ecosystems in the region. There is a need to monitor trading of wild-caught animals in pet markets in the region, as well as to investigate the origin of traded pets to alleviate the capture of wild birds for trade purposes. Only then would wild birds be saved from being traded and the integrity of wild habitat be protected against new invasions.

### Acknowledgements

The authors would like to thank all members of the Birds Monitoring Group for sharing their observations and their help in monitoring. Furthermore, the authors would also like to thank two anonymous reviewers for reviewing an earlier version of the manuscript.

### Funding

This project was supported by Imam Abdulrahman Bin Faisal University, Deanship of Scientific Research funding: BASRC 2020-130.

### References

- Aloufi A, Eid E (2014) Conservation perspectives of illegal animal trade at markets in Tabuk, Saudi Arabia. *Traffic Bulletin* 26: 77–80, [https://www.traffic.org/site/assets/files/3006/traffic\\_publication\\_bulletin\\_26\\_2\\_wildlife\\_markets\\_tabuk\\_saudi\\_arabia.pdf](https://www.traffic.org/site/assets/files/3006/traffic_publication_bulletin_26_2_wildlife_markets_tabuk_saudi_arabia.pdf)
- Alshamlieh M, Alzayer M, Hajwal H (2020) Rüppell's weaver, *Ploceus galbula* Rüppell, 1880 invasion of the Eastern Arabian Peninsula: potential economic and social impacts. *BioInvasions Records* 9: 158–164, <https://doi.org/10.3391/bir.2020.9.1.20>

- Alves RRN, Lima JRDF, Araujo HFP (2013) The live bird trade in Brazil and its conservation implications: an overview. *Bird Conservation International* 23: 53–65, <https://doi.org/10.1017/S095927091200010X>
- BirdLife International (2018) *Crithagra rothschildi*. The IUCN Red List of Threatened Species 2018: e.T22720122A131998798, <https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22720122A131998798.en>
- Blackburn TM, Bellard C, Ricciardi A (2019) Alien versus native species as drivers of recent extinctions. *Frontiers in Ecology and the Environment* 17: 203–207, <https://doi.org/10.1002/fee.2020>
- Brochet AL, Jbour S, Sheldon R, Porter R, Jones VR, Al Farazi W, Angrwin R (2019) A preliminary assessment of the scope and scale of illegal killing and taking of wild birds in the Arabian peninsula, Iran and Iraq. *Sandgrouse* 41: 155–175
- Bush ER, Baker SE, Macdonald DW (2014) Global Trade in Exotic Pets 2006–2012. *Conservation Biology* 28: 663–676, <https://doi.org/10.1111/cobi.12240>
- Carpio AJ, Álvarez Y, Oteros J, León F, Tortosa FS (2020) Intentional introduction pathways of alien birds and mammals in Latin America. *Global Ecology and Conservation* 22: e00949, <https://doi.org/10.1016/j.gecco.2020.e00949>
- Carrete M, Tella JL (2008) Wild-Bird Trade and Exotic Invasions: A New Link of Conservation Concern? *Frontiers in Ecology and the Environment* 6: 207–211, <https://doi.org/10.1890/070075>
- Castell P, Coburn J, Pleasance B, Williams S (2001) Notes on the breeding biology of some Arabian birds. *Sandgrouse* 23: 49–58. [http://nwrc.gov.sa/NWRC\\_ENG/Other\\_birds\\_publications\\_files/1-2001-012.pdf](http://nwrc.gov.sa/NWRC_ENG/Other_birds_publications_files/1-2001-012.pdf)
- Clavero M, Brotons L, Pons P, Sol D (2009) Prominent role of invasive species in avian biodiversity loss. *Biological Conservation* 142: 2043–2049, <https://doi.org/10.1016/j.biocon.2009.03.034>
- Courchamp F, Fournier A, Bellard C, Bertelsmeier C, Bonnaud E, Jeschke JM, Russell JC (2017) Invasion Biology: Specific Problems and Possible Solutions. *Trends in Ecology & Evolution* 32: 13–22, <https://doi.org/10.1016/j.tree.2016.11.001>
- Dick JTA, Laverty C, Lennon JJ, Barrios-O’Neill D, Mensink PJ, Robert Britton J, Caffrey JM (2017) Invader Relative Impact Potential: a new metric to understand and predict the ecological impacts of existing, emerging and future invasive alien species. *Journal of Applied Ecology* 54: 1259–1267, <https://doi.org/10.1111/1365-2664.12849>
- Gurevitch J, Padilla DK (2004) Are invasive species a major cause of extinctions? *Trends in Ecology & Evolution* 19: 470–474, <https://doi.org/10.1016/j.tree.2004.07.005>
- Jennings MC (2010) Atlas of the breeding birds of Arabia. Senckenbergische Naturforschende Gesellschaft, Frankfurt, Germany, 751 pp
- Lowe S, Browne M, Boudjelas S, De Poorter M (2000) 100 of the world’s worst invasive alien species: a selection from the global invasive species database (Vol. 12): Invasive Species Specialist Group Auckland. <https://portals.iucn.org/library/sites/library/files/documents/2000-126.pdf>
- Maxwell SL, Fuller RA, Brooks TM, Watson JE (2016) Biodiversity: The ravages of guns, nets and bulldozers. *Nature News* 536: 143, <https://doi.org/10.1038/536143a>
- Porter R (2014) The mystery of the ‘Syrian’ Serins wintering in northern Iraq is solved. *Sandgrouse* 36: 58–60. <https://www.osme.org/wp-content/uploads/2019/10/G-Porter-Sandgrouse-36-1-2014.pdf>
- Porter R, Aspinall S (2010) Birds of the Middle East. 2<sup>nd</sup> edition. Christopher Helm, London, 373 pp
- Pyšek P, Pyšek P, Hulme PE, Simberloff D, Bacher S, Blackburn T, Carlton JT, Dawson W, Essl F, Foxcroft LC, Genovesi P, Jeschke JM, Kühn I, Liebhold AM, Mandrak NE, Meyerson LA, Pauchard A, Pergl J, Roy HE, Seebens H, Van Kleunen M, Vilà M, Wingfield MJ, Richardson M (2020) Scientists’ warning on invasive alien species. *Biological Reviews* 95: 1511–1543, <https://doi.org/10.1111/brv.12627>
- Reino L, Figueira R, Beja P, Araújo MB, Capinha C, Strubbe D (2017) Networks of global bird invasion altered by regional trade ban. *Science Advances* 3: e1700783, <https://doi.org/10.1126/sciadv.1700783>
- Shobrak M, Al Fagih AS (2012) Wildlife Trade in Taif Region. *Phoenix* 28: 18–19. <https://www.biodiversitylibrary.org/item/212197#page/18/mode/1up>
- Smith KF, Behrens M, Schloegel LM, Marano N, Burgiel S, Daszak P (2009) Reducing the Risks of the Wildlife Trade. *Science* 324: 594–595, <https://doi.org/10.1126/science.1174460>
- Symes A, Taylor J, Mallon D, Porter R, Simms C, Budd K (2015) The Conservation Status and Distribution of the Breeding Birds of the Arabian Peninsula. Cambridge, UK and Gland, Switzerland: IUCN, and Sharjah, UAE: Environment and Protected Areas Authority, 56 pp, <https://doi.org/10.2305/IUCN.CH.2015.MRA.5.en>