

**Rapid Communication****Rüppell's weaver, *Ploceus galbula* Rüppell, 1880 invasion of the Eastern Arabian Peninsula: potential economic and social impacts**Mohammed Alshamli<sup>1,2,\*</sup>, Mohammed Alzayer<sup>3</sup> and Faisal Hajwal<sup>4</sup><sup>1</sup>Biology Department, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia<sup>2</sup>Basic and Applied 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>Birds Monitoring Group, Dammam, Saudi ArabiaAuthor e-mails: [mmalshamli@iau.edu.sa](mailto:mmalshamli@iau.edu.sa) (MAlS), [malzayer@kfu.edu.sa](mailto:malzayer@kfu.edu.sa) (MAlZ), [Fahajwal@gsa.gov.sa](mailto:Fahajwal@gsa.gov.sa) (FH)

\*Corresponding author

**Citation:** Alshamli M, Alzayer M, Hajwal F (2020) Rüppell's weaver, *Ploceus galbula* Rüppell, 1880 invasion of the Eastern Arabian Peninsula: potential economic and social impacts. *BioInvasions Records* 9(1): 158–164, <https://doi.org/10.3391/bir.2020.9.1.20>

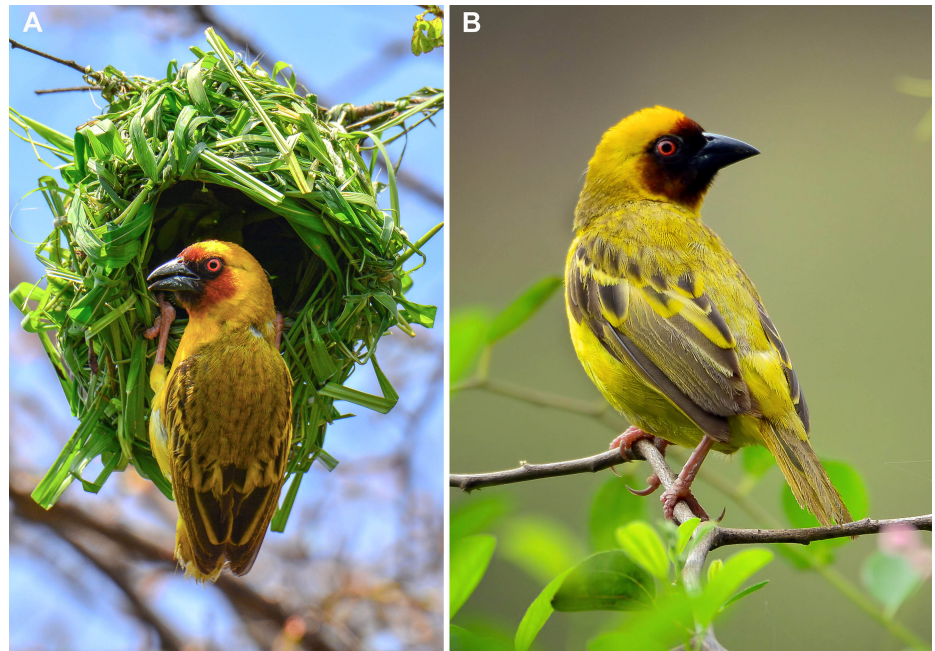
**Received:** 7 August 2019**Accepted:** 3 November 2019**Published:** 17 January 2020**Handling editor:** Luis Reino**Thematic editor:** Stelios Katsanevakis**Copyright:** © Alshamli et al.This is an open access article distributed under terms of the Creative Commons Attribution License ([Attribution 4.0 International - CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)).**OPEN ACCESS****Abstract**

In this article we report the first invasion of Rüppell's weaver (*Ploceus galbula*) into the Palearctic biogeographic zone. This research documents the introduction and spread of Rüppell's weaver in the Eastern Province, Saudi Arabia. Because the Rüppell's weaver are not strong fliers, their introduction is almost certainly caused by escapees and deliberate releases of birds brought in by pet trade. Subsequently, Rüppell's weavers were able to breed and spread, feeding on the seasonal crops, while exhibiting the ability to utilize variable food sources. After the first introduction in the Al-Qatif city, the weavers spread north and south. This report highlights the potential ecological, economic and social impacts of the weaver's invasion in the Eastern Province of Saudi Arabia. Lastly, the importance of a comprehensive study assessing the effects the Rüppell's weaver has in these invaded habitats is highlighted.

**Key words:** biological invasion, birds, hyper-arid desert, Saudi Arabia, ecological impact**Introduction**

Rüppell's weaver, *Ploceus galbula*, is a member of the Ploceidae family residing in the Afrotropical biogeographic zone (BirdLife International 2018). Within the family, the only weaver of an Asian extension of its Afrotropical distribution is the Rüppell's weaver that resides in southern Oman, Yemen and southwest Saudi Arabia (BirdLife International 2018; Porter and Aspinall 2010). In Saudi Arabia, Rüppell's weaver inhabits the southwestern mountains extending northward from Jazan at the Yemeni border to Yanbu Alnakhil (Jennings 2010). In its native habitat, *P. galbula* inhabits wadis with acacia and crop lands below 2500 m altitude (Bruggers 1980; Porter and Aspinall 2010). However, in Eritrea and Somalia, it resides in coastal scrubs, bushy habitats in semi-arid regions and cultivated land (Ash and Atkins 2009).

Rüppell's weaver is a passerine with a distinctive dimorphism. Females are dull and streaky, similar to sparrows-Passer species, whereas males are



**Figure 1.** Photographs of the Rüppell's weaver in Al-Qatif city, A: a male building nest, B: male perching. Photos by F. Hajwal (A) and M. Alzayer (B).

yellow and black in plumage. Nonbreeding males are as discrete as the females. *P. galbula* breeds all year round with nest building being performed exclusively by males to attract females. Nests are built on trees 4–6 m above ground, however, in Arabia 2 m or higher (M. Jennings *pers. comm.*). The occurrence of nest communities composed of hundreds of nests is not uncommon. The number of eggs per nest varies (but in Arabia it is usually two or three eggs with four being the maximum (Jennings 2010)), peaking in June and July, and reaching their lowest records from August to January (Ash and Atkins 2009). Rüppell's weaver is a gregarious species often seen in groups of five to ten birds, but flocks of as many as 1000 birds in Eritrea have been reported (Ash and Atkins 2009) and 1000 have been noted going to roost in Arabia (Jennings 2010).

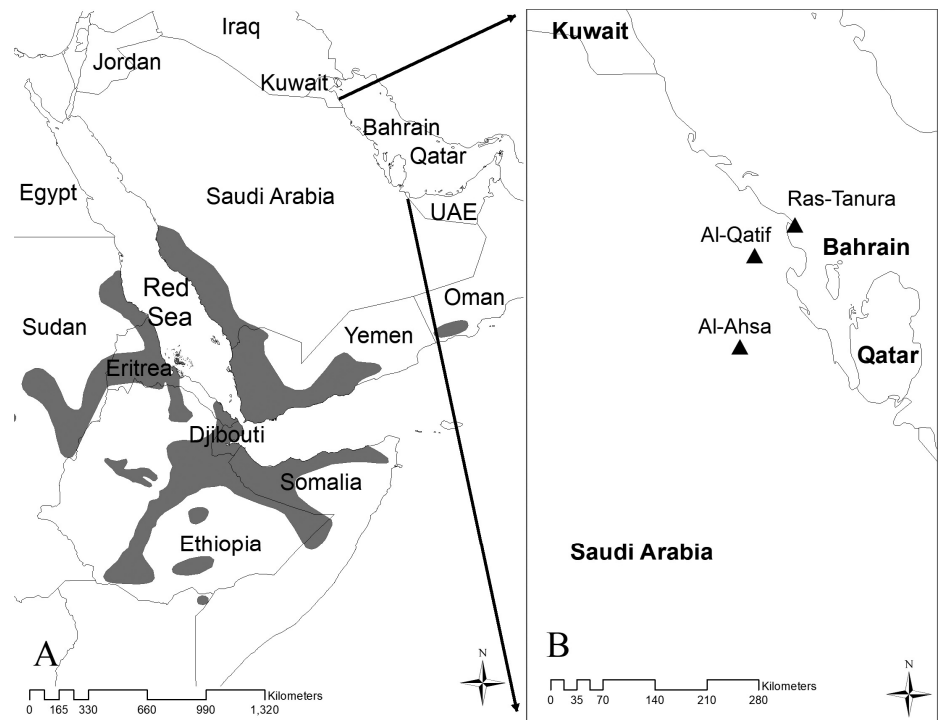
This paper describes the introduction and establishment of the Rüppell's weaver beyond its Afrotropical native range. In addition, this study also discusses the subsequent spread and establishment of the species into novel habitats, reporting on its nesting and feeding behaviors.

### Materials and methods

All observations of the Rüppell's weaver were part of the annual systematic avian survey in the Eastern Province carried out by the Birds Monitoring Group. Since 2011, monitoring of *P. galbula* in the Al-Qatif city has been regularly producing notes on habitat use and feeding behavior.

#### Survey sites

Surveys are carried out in Al-Qatif city, Al-Ahsa, and Ras-Tanura to the west of the Arabian Gulf (Figure 1). Al-Qatif and Al-Ahsa are mainly agricultural



**Figure 2.** Distribution of Rüppell's weaver, A: native distribution of the Rüppell's weaver (shaded). B: invasive range of Rüppell's weaver in the Eastern Province. Black triangles represent the invasion location: Al-Qatif, Ras Tanura, and Al-Ahsa.

cities but, Ras Tanura is an industrial city. Despite the hyper-arid deserts surrounding Al-Qatif and Al-Ahsa, both cities are known for yearlong abundance of natural freshwater springs, with over 150 springs in an area of 275 km<sup>2</sup>. The abundance of freshwater, along with associated farming activities, has facilitated human colonization since 3000 BC (Vincent 2008).

## Results

The first observation of the Rüppell's weaver was reported by a member of the Birds Monitoring Group, Jaffar Srew, in February 2011 (Figure 1). Two birds, a male and a female were initially sighted in Al-Qatif (26.533522N; 50.000595E) consisting the very first record of Rüppell's weaver in all of the Eastern Province (Figure 2). Subsequently, the birds were tracked and followed yearly since their first detection in the southern parts of Al-Qatif. *P. galbula* breeding was confirmed in 2012, through nest building and sighting of fledglings. Successive observations since 2012 recorded successful breeding and an annual increase of *P. galbula* abundance (Figure 1). The Rüppell's weaver presence was observed to expand spatially into new habitats, forming several colonies across Al-Qatif area by 2019.

Within Al-Qatif, our observation indicates that nest building of *P. galbula* commences in February on Button mangrove, *Conocarpus lancifolius*, at a height of 4–6 m. After 2011, birds were observed nesting on multiple plant species (Table 1). Two of the most commonly used plant species for nest building, Button mangrove and Monkeypod, *Pithecellobium dulce*, are invasive in Al-Qatif (Thomas et al. 2016). Between December and June, the

**Table 1.** Plant species associated with *P. galbula* breeding.

Common name	Scientific name	Status
Button mangrove	<i>Conocarpus lancifolius</i>	Introduced
Monkeypod	<i>Pithecellobium dulce</i>	Introduced
White mulberry	<i>Morus alba</i>	Native (naturalized)

Rüppell's weaver feeds mostly on crops in Al-Qatif, and from July to November, it feeds almost exclusively on dates.

As of 2019, Rüppell's weaver extended its range in the Eastern Province beyond Al-Qatif city. In February 2019, it was recorded for the first time in Al-Ahsa city, 170 km south of Al-Qatif (Figure 2). Furthermore, sightings in Ras-Tanura, an industrial city north of Al-Qatif, were confirmed in April 2019 (Figure 2). It is important to note that the habitat between Al-Qatif and Al-Ahsa is composed of inhospitable hyper-arid sand dunes, but, Ras Tanura, less than 20 km away, is in very close geographic proximity to Al-Qatif.

## Discussion

Our records provide evidence for the successful establishment of Rüppell's weaver in the Eastern Province. Within eight years, the weavers have established several colonies in Al-Qatif city. Furthermore, the spread of the *P. galbula* northeast to Ras-Tanura and south to Al-Ahsa city is reported for the first time. The successful introduction, establishment and spread of Rüppell's weaver is alarming, as it is the first recorded invasion of this species. Rüppell's weaver sightings were reported in Riyadh between 1985 and 1992. However, despite their successful breeding during the first few years, that colony died out by 1992 (Jennings 2010). Surprisingly, during the revision of this article, the authors received confirmed sightings of a breeding pair in Wadi Haneefah, Riyadh, 400 km west of Al-Qatif. Upon further investigation, it was confirmed that the pair was deliberately introduced by locals. Similarly, the expansion of Rüppell's weaver to Al-Qatif cannot be attributed to natural spread from their native range 1200 km to the south-west, because Rüppell's weaver is known to have a weak power of flight. Perhaps, both introductions originated from national pet trade, as Rüppell's weaver trading was previously reported in Taif, Saudi Arabia (Shobrak and Al Fagih 2012). Further sightings from the United Arab Emirates and Kuwait were also reported, with no knowledge of the weavers' breeding status (M. Jennings *pers. comm.*/ABBA database). These sightings, further away in Kuwait and United Arab Emirates, would be impossible without pet trade introduction. Therefore, the introduction of Rüppell's weaver in the Arabian Peninsula could be only carried out by a single vector of introduction; that is pet trade.

Invasive species threaten biodiversity and human well-being globally. In the United States alone, the economic and environmental damage of invasive species are estimated to be around 120 billion dollars a year (Pimentel et al. 2005). Ecologically, the impact of invasive species may

range from competition for food and habitat resources to the introduction of novel diseases and predation of native species (Clavero and García-Berthou 2005; Gallardo et al. 2016; Maresh Nelson et al. 2018; Martin-Albarracin et al. 2015; Mooney and Cleland 2001). Besides the direct economic impact posed by invasive species on agricultural productivity, human impacts are well documented. For instance, invasive species pose a risk to public health by transmitting human diseases and affecting social activities, ecotourism and leisure (Vilà and Hulme 2017).

Rüppell's weaver's introduction in the Eastern Province warrants special attention, because the two cities are oases in the center of the Arabian deserts. Both cities are known as the vegetable basket of the desert; producing high quality vegetables and fruits in a hyper-arid environment (Facey 2001). Al-Qatif, one of the oldest cities on the Arabian Gulf, is known for its massive vegetable fields, thus its name "Al-Qatif" meaning "to cultivate" in the Arabic language. The city holds about 5500 ha of farmland; one of the biggest natural farmlands in a hyper-arid environment in the world (Vincent 2008). Similarly, Al-Ahsa is a major agricultural city in Saudi Arabia that depends primarily on farming as an economic activity that has extended for thousands of years. Furthermore, Al-Ahsa is one of the very few sites in the Arabian Peninsula known for growing rice.

The introduction of Rüppell's weaver in the Eastern Province is expected to potentially have ecological and economic impacts. The Rüppell's weaver would potentially compete with native biota on limited resources and cause substantial crops damage (Bruggers 1980). In its native habitat, the species is known as a pest because of its feeding ecology and behaviour (Maurice et al. 2017). Irrigated low-land farms sustained a 50% production decline because of weaver birds in Somalia (Bruggers 1980; Maurice et al. 2017). Being granivorous, the Rüppell's weaver has been observed feeding on maize, sorghum, wheat and sesame in Yemen (Jennings 2010). In addition, feeding on other sources such as acacia seeds, nectar and insects has been documented in other areas. It's been documented that flexibility in feeding can substantially improve invasive species establishment and impacts (Webb et al. 2014). In Al-Qatif, Rüppell's weavers exhibit flexible feeding behaviour; feeding on available seasonal crops such as dates, figs, blackberries and grains. Rüppell's weaver was observed feeding on human food scraps, especially dried bread in Al-Qatif. Furthermore, Rüppell's weaver behavior as a gregarious bird during feeding and breeding, with flocks of hundreds, would ultimately increase their impacts. Thus, based on feeding ecology and behavior, the Rüppell's weaver potential impact may not only be limited to locally grown grains, but could extend to almost all seasonal cultivated crops. Based on preliminary observations, we predict that the Rüppell's weaver consumption of wide spectrum of food sources may potentially pose a risk to the economic sustainability of the region, mainly if this species becomes a pest in the future. Therefore, a detailed assessment

of the Rüppell's weaver potential ecological and economic impacts in its invasive range is urgently needed in order to direct management plans.

Besides the direct ecological and economic impact of this invasion, an impact on the cultural practices and heritage is a potential concern. Agricultural practices in both cities extends thousands of years to the earliest human settlement in the Neolithic. The traditions of locals in both oases are intertwined with the continuation of their agriculture heritage. Despite the economic change caused by the flourishing oil industry in the region, native residents of both oases are dependant on their land and are linked to the inherited agricultural practices. The nomination of Al-Ahsa as a heritage site, since 2018, was primarily for its resident's interaction with nature. Therefore, the introduction of the Rüppell's weaver to both oases could potentially impact not only the economy but also the region's cultural heritage.

This paper documents the alarming introduction of the Rüppell's weaver in two oases in the Arabian desert. The recorded introduction, along with other documented cases, underscores the significant impact of pet trade in species introductions in novel habitats (Early et al. 2016; Reino et al. 2017). In addition, the paper underlines the importance of active monitoring to improve the success of early detection, prevention and even eradication actions. Furthermore, it highlights the need for an overarching regulation at a regional level to curtail the effect of pet trade on native communities (Reino et al. 2017).

## Acknowledgements

The authors would like to thank all members of the Birds Monitoring Group for sharing their observations. Furthermore, the authors would like thank Dr. May Khalili, and Mike Jennings for reviewing earlier versions of this manuscript, and anonymous reviewer and the handling editor L. Reino for their input on the submission.

## References

- Ash J, Atkins J (2009) Birds of Ethiopia and Eritrea: An Atlas of Distribution. Christopher Helm, London, United Kingdom, 464 pp
- BirdLife International (2018) *Ploceus galbula*. The IUCN Red List of Threatened Species 2018: e.T22718860A132121792
- Bruggers RL (1980) The Situation of Grain-Eating Birds in Somalia. Paper presented at the The Ninth Vertebrate Pest Conference, California, USA, <https://digitalcommons.unl.edu/vpc9/4/>
- Clavero M, García-Berthou E (2005) Invasive species are a leading cause of animal extinctions. *Trends in Ecology & Evolution* 20: 110, <https://doi.org/10.1016/j.tree.2005.01.003>
- Early R, Bradley BA, Dukes JS, Lawler JJ, Olden JD, Blumenthal DM, Tatem AJ (2016) Global threats from invasive alien species in the twenty-first century and national response capacities. *Nature Communications* 7: 12485, <https://doi.org/10.1038/ncomms12485>
- Facey W (2001) The Story of the Eastern Province of Saudi Arabia. Stacey International, London, United Kingdom, 160 pp
- Gallardo B, Clavero M, Sánchez MI, Vilà M (2016). Global ecological impacts of invasive species in aquatic ecosystems. *Global Change Biology* 22: 151–163, <https://doi.org/10.1111/gcb.13004>
- Jennings MC (2010) Atlas of the breeding birds of Arabia (Vol. 25). Senckenbergische Naturforschende Gesellschaft Frankfurt, Germany, 752 pp
- Mareh Nelson SB, Coon JJ, Duchardt CJ, Miller JR, Debinski DM, Schacht WH (2018) Contrasting impacts of invasive plants and human-altered landscape context on nest

- survival and brood parasitism of a grassland bird. *Landscape Ecology* 33: 1799–1813, <https://doi.org/10.1007/s10980-018-0703-3>
- Martin-Albarracin V, Amico GC, Simberloff D, Nuñez MA (2015) Impact of non-native birds on native ecosystems: A global analysis. *PLoS ONE* 10: e0143070, <https://doi.org/10.1371/journal.pone.0143070>
- Maurice ME, Fuashi NA, Agiamte-Mbom VB, Lengha TK (2017) The Farmers' Perception on Weaverbird Pest on Agricultural Crop Damage in Ekona Farming Area, Southwest Region, Cameroon. *Journal of Biodiversity Management and Forestry* 6: 1–5, <https://doi.org/10.4172/2327-4417.1000178>
- Mooney HA, Cleland EE (2001) The evolutionary impact of invasive species. *Proceedings of the National Academy of Sciences* 98: 5446–5451, <https://doi.org/10.1073/pnas.091093398>
- Pimentel D, Zuniga R, Morrison D (2005) Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52: 273–288, <https://doi.org/10.1016/j.ecolecon.2004.10.002>
- Porter R, Aspinall S (2010) *Birds of the Middle East*. Christopher Helm, London, United Kingdom, 384 pp
- 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, Saudi Arabia. *Phoenix* 28: 18–19
- Thomas J, El-Sheikh MA, Alfarhan AH, Alatar AA, Sivadasan M, Basahi M, Rajakrishnan R (2016) Impact of alien invasive species on habitats and species richness in Saudi Arabia. *Journal of Arid Environments* 127: 53–65, <https://doi.org/10.1016/j.jaridenv.2015.10.009>
- Vilà M, Hulme PE (2017) Non-native Species, Ecosystem Services, and Human Well-Being. In: Vilà M, Hulme PE (eds), *Impact of Biological Invasions on Ecosystem Services. Invading Nature – Springer Series in Invasion Ecology*, vol 12. Springer, Cham, pp 1–14, [https://doi.org/10.1007/978-3-319-45121-3\\_1](https://doi.org/10.1007/978-3-319-45121-3_1)
- Vincent P (2008) *Saudi Arabia: An Environmental Overview*. CRC Print, London, United Kingdom, 538 pp, <https://doi.org/10.1201/9780203030882>
- Webb JK, Letnic M, Jessop TS, Dempster T (2014) Behavioural flexibility allows an invasive vertebrate to survive in a semi-arid environment. *Biology Letters* 10: 20131014, <https://doi.org/10.1098/rsbl.2013.1014>