



The Geographical Distribution of House Crows in the Southern Sultanate of Oman (Dhofar Governorate) Based on their Eradication Numbers

Rahma Al Nadhairi^{1*}, Suleiman Al Akhazami¹, Talib Al Abri¹, Ahmed Al Shukaili¹, Munira Al Balushi¹, Zeyana Al Omairi¹ and Mohammed Akak²

¹Department of Environment Authority and General Directorate of Nature Conservation, Sultanate of Oman

²Dhofar Municipality, Department Directorate General for Health Affairs, Salalah, Sultanate of Oman

*Corresponding Author: Rahma Al Nadhairi, Department of Environment Authority and General Directorate of Nature Conservation, Sultanate of Oman; E-mail: rahma.alnadhairia@ea.gov.om

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Abstract

The Indian House Crow (*Corvus splendens*) denotes an avian invasive species that has rapidly spread throughout the Sultanate of Oman, posing significant threats to livestock and competes aggressively with native birds thereby endangering biodiversity in the Omani environment. This study aimed to assess the geographic distribution of House Crows by quantifying the number of individuals eradicated using cricket air guns from December 2022 to June 2023 in the Dhofar Governorate, located in the southern Oman. The study focused on four coastal cities: Salalah, Sadah, Mirbat, and Taqah. Results indicated that the highest number of House Crows were eradicated in Salalah, totaling 48,028 individuals, followed by Taqah and Mirbat with 4,127 and 727, respectively. Sadah recorded the lowest count at 28 individuals. The presence of House Crows was found to be closely associated with human population size, density, and proximity to major fishing port villages. This study provides critical insights into the current status of House Crows in the Dhofar Governorate, enhancing management strategies for invasive species and promoting cost-effective ecosystem sustainability efforts.

Keywords: House crows; Invasive species; Indigenous biodiversity; Dhofar forest mountains; Environment sustainable

Introduction

Corvus splendens (*C. splendens*), also known as the House Crow (gray necked Crow), signifies a common species indigenous to Asia [1]. Despite being native to the Indian subcontinent, it has rapidly expanded its habitat distribution to encompass Europe, the Middle East, and Australia (Figure 1).

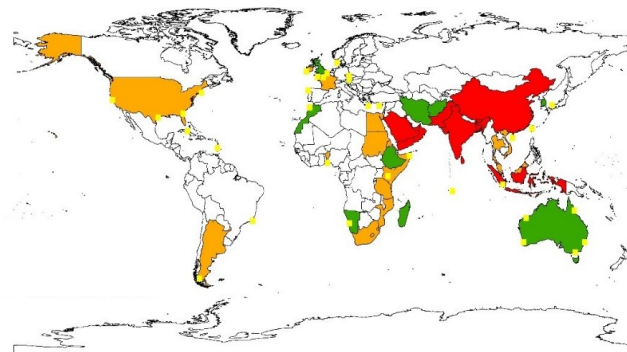


Figure 1: Distribution and expansion of *C. splendens* (Source: Modified from www.oiseaux.net). **Note:** Native/Nesting (■); Introduced/Reintroduced (■); Rare/Occasional (■); Occurrence of lone birds (■).

Eastern Africa, East Asia, and the Americas (Figure 1). Although typically found in lowland areas, it has been observed at elevations as high as 4,240 meters in the Himalayas [2]. They are among the most invasive species that can establish significant populations in the urban environments [3]. This species is a serious agricultural pest, feeding on a variety of crops at different developmental stages [4,5]. The rapid increase in House Crow populations has led to numerous problems, including damage to buildings and tourist attractions, noise pollution, competition with native birds, and loss of local biodiversity [6,7]. Their adaptability allows them to easily access new habitats, increasing their chances of reproduction and survival [8]. International trade and travel have facilitated the dispersal of House Crows, as these animals can hide on ships or be transported in vehicles, introducing them to new areas. *C. splendens* has a diverse diet, consuming human food scraps, fruits, insects, and small vertebrates [9]. This species has exceptional ecological adaptability and is highly dependent on the presence of humans, so no populations have been discovered without human interaction [10].

House Crows are known carriers of various pathogenic organisms, posing a significant risk of spreading diseases such as West Nile Virus (WNV), cholera, and dysentery. These viruses can be transmitted to humans from infected poultry or directly from *C. splendens* [11]. For example, WNV can be transmitted between birds via feces and oral secretions. In Orange County, California, 1,513 bird carcasses were found to be infected with WNV between 2004 and 2013 [12]. Additionally, H₅N₁ and H₉N₂ avian influenza viruses circulated among many bird species, including House Crows, causing deaths in India from 2009-2011 in India [13] and in 2004 in Thailand [14].

The Dhofar Governorate is undoubtedly a pillar of economic growth in the Sultanate, and its crops (coconuts, papaya and bananas) contribute to the productivity of the agricultural sector. However, these birds are damaging crops, particularly papayas, bananas, and mangoes. Local and migratory birds, as well as an outbreak of the invasive Indian crow occupying large nesting areas, pose a serious threat. Additionally, these invasive birds affect dry fish production, and attack chicks on farms.

It has been observed that invasive birds such as House Crows pose a threat to indigenous biodiversity in the Sultanate of Oman and have become increasingly aggressive. It is believed that the British were the first ones to introduce this species in Aden and Zanzibar (which was

formed part of the Oman emperor) to the world in the late 1800s. This facilitated waste disposal and possibly led to their later introduction to Oman *via* ships from India. In 2022, a national campaign was launched in Dhofar Governorate to eradicate House Crows. This study examines their geographic distribution by identifying the areas they inhabit and counting how many have been eradicated. This study also offers insights into the changes in Oman's environmental systems through the implementation of international agreements, such as the Convention on Biological Diversity (CBD) and the International Union for Conservation of Nature (IUCN), which aim to protect local species and promote sustainable use of environmental resources.

Methodology

Study area

The study area encompasses the southern part of Oman within the Dhofar Governorate (Figure 2). It is bordered to the southeast by the Arabian Sea, to the south by the Republic of Yemen, and to the northwest by the Empty Quarter desert (Figure 2). Salalah, is the largest city in this region and has a high population density (Figure 2).



Figure 2: A map illustrating the Dhofar portion of the South Oman along mountain forest ranges (Green with brown regions). The inset box figure (Red box) illustrates Dhofar's location relative to the Arabian Peninsula. Images below depict forest mountain ranges in Dhofar (Left), House Crow (Center), and Mirbat fish village (Right).

In the wake of its varied terrain, the area features two distinct physiographic zones: the mountain ranges of Jabal Samhan, Jabal Qara, and Jabal Qamar, and the Salalah plain along the coast. In the mountain forests, the elevation rises sharply from the flat coastal plain to about 2,100 meters. The climate in the Dhofar Governorate is generally arid, with cooler summers compared to the inland areas of Oman [15]. During the summer monsoon season (Khareef) from June to September, south-westerly winds bring cold water up through upwelling, reducing air temperatures to 18°C and increasing rainfall to 100 mm [15].

It is the only region in the Arabian Peninsula to be affected by the south west monsoon. Therefore, thick clouds and high humidity prevail in the Dhofar Governorate during Khareef season. Salalah's landscape undergoes a dramatic transformation during the Khareef season. As a result, rolling hills and valleys covered in thick vegetation transform the usual arid and desert-like terrain into lush and green. Cooler temperatures also create a pleasant climate that draws

tourists from all over Oman, the Gulf and beyond. The Dhofar mountain ranges are a biodiversity hotspot on the Arabian Peninsula, abundant in trees, woody plants, and forests with unique lush vegetation due to their location between Africa and Asia. Unique trees such as frankincense and Adansonia (locally known as "Baobab" trees) have historical significance and links to ancient civilizations. Additionally, there are over 50 plant species that are endemic to this region and found nowhere else in the world [16].

Dhofar is also set for significant economic growth in the fishing industry. The Port of Salalah and the fish ports of Mirbat and Taqah are key export points. For birdwatchers, Dhofar is a paradise [17]. Strategically positioned along migratory routes, the region is a crucial rest stop for numerous bird species during their annual migrations. Flamingos, herons, and storks brighten the coastal marshes with their vibrant colors. Birds' endemic and migratory to the country are found primarily in the Dhofar Governorate. Birds can be categorized based on the environment in which they live and breed in the coast, mountains, and desert. The coastal areas feature islands and creeks where seawater mixes with valley water, attracting migratory birds from Africa, India, and the southwest Arabian Peninsula. The coastline attracts bird's species such as Egyptian vultures, petrels, and gulls. The mountains host many endemic birds, including eagles, Arabian partridges, and African owls. Desert plains provide habitats for fewer bird species, some of which have unique adaptations. Generally, crows are mostly found along the coastline but also appear in the mountains in smaller numbers compared to coastal regions.

In this study, we chose four major locations (Salalah, Sada, Mirbat, and Taqah) to eradicate House Crows from December 2022 to June 2023 to analyze the correlation between the geographical distribution of the House Crow at different major cities and villages in the Dhofar Governorate (Figure 2). On the basis of information from local expert guides, House Crows were identified using field glass binoculars. The Environment Authority of Oman has tested several methods for controlling them, including the use of cages and poisoned food. Avicides such as Starlicide™ (DRC 1339) are commonly used to eliminate House Crows in large numbers, a method that has been successfully implemented in mainland Yemen before [18].

Based on observations, House Crows exhibit a behavior where they wait for other birds to enter cages before entering themselves. In response, the Environment Authority chose to employ cricket air guns for control measures. Skilled hunters conducted the shooting, guided by field supervisors who briefed them on identifying invasive bird species. Shooting operations were conducted from a four-wheel-drive vehicle using a silenced cricket air gun. When crows were sighted, trained guides ensured safe and efficient shooting. Counting House Crows presents its challenges, so Oman Environmental Services Holding Company (Be'ah) undertook the responsibility for counting and disposing of the eliminated crows. Be'ah delivers expert solutions for managing and handling eradicated crows and associated waste through innovative approaches.

Results

Considering House Crows' mobility, controlling them requires a collaborative effort. It was imperative to publish this material to encourage other local authorities to control invasive species within their municipalities. Data presented in Table 1 generally revealed that the population of the House Crow combated from December 2022 to June 2023 (Tables 1 and 2).

Area	Time period	House Crows
Salalah	13/12/2022-10/5/2023	28153
	23/5/2023-3/6/2023	16249
	4/6/2023-15/6/2023	3626
Taqah	13/12/2022-10/5/2023	3585
	23/5/2022-3/6/2023	542
Mirbat	13/12/2022-10/5/2023	727
Sadah	13/12/2022-10/5/2023	28
Total		52910

Table1: Time period and total number of House Crows eradicated in Dhofar Governorate.

Area	Human population	Eradicated the number of House Crows
Salalah	331949	34733
Taqah	21487	4127
Mirbat	16364	727
Sadah	6016	28

Table 2: Human population size of each city in Dhofar Governate and its relation to the eliminated numbers of House Crow (Source: National Center for Statistical Information for 2020).

The findings indicate a notable decline in House Crow populations in Salalah from December 2022 to May 2023 compared to June 2023, suggesting higher numbers of these birds in winter and spring than in summer. Data revealed that the largest number of House Crows was eradicated in Salalah's main city, totaling 48,028 individuals, followed by 4,127 in Taqah. Mirbat recorded the lowest number at 727, with Sadah even lower at 28, resulting in a total eradication count of approximately 52,910 House Crows. The results also showed that House Crows tended to avoid lingering at locations once they detected the presence of observers or the jeep. Additionally, there was observed movement of crows towards mountainous areas.

Discussion

It is remarkable that Indian House Crow species successfully invaded different locations in the world and posing significant threats to wildlife and biodiversity. Study results over Dhofar Governorate indicate that the presence and number of House Crows are high in Salalah, the city with the highest density of people [19,20]. House Crows had spread to adjacent areas of Mirbat, Sadah and Taqah for nesting. As a result of their introduction into urban areas, house crows establish a foundation for growth by establishing a founder population. By adapting to various food sources, from human and fishing waste they can establish populations in a variety of environments. House Crows are known to monitor human behavior and gain benefits from this observation. As a result, it shouldn't surprise us that urban, commercial, and port areas with waste would have exponential growth of crows. Table 2 presents human population size of each city in Dhofar Governate and its relation to the eliminated numbers of House

Crow. Observations also revealed large numbers of these birds in Salalah city area and adjacent fishing port villages.

A study by Dutta and Raut (2013), House Crows exhibit a preference for nesting close to human settlements, which enhances their chances of survival, protection, and efficient foraging [21]. Their nests, typically constructed from securely fastened metal wires, reflect their adaptive strategies within human-dominated landscapes.

The accumulation of organic materials within these ecosystems not only supports House Crow populations but also fosters increased microbial and pest activity, necessitating robust waste management practices to safeguard human health and ecological balance. Effective waste management guidelines, grounded in Oman's best practices, are essential, particularly in fishing ports where waste generation is substantial. Additionally, monitoring ship traffic between Salalah port and other key ports across the Middle East, India, and East Africa is critical to managing the rapid growth of House Crow populations, which can strain financial and logistical resources if left unchecked. Given the potential implications for biodiversity and the economy, failure to effectively manage House Crow populations could have far-reaching consequences. To mitigate their adverse effects on native species, a comprehensive management plan has been proposed, as outlined in (Table 3).

Determine crows' locations	Identify new locations spots and confirm if the locations are active. Social media public awareness.
Estimate crow abundance	Perform crow's survey (such as population size, breeding activities). Examine impacts of crow's abundance on biodiversity. Developing a database and using geographic information systems to identify nesting sites.
Reduce crow abundance	Targeted shooting, trapping, visual scare devices. Evaluating wastes from fishing ports, mountain ranges and urban areas.
Continuous monitoring	Examining status and trends of crows Estimating status of biodiversity such as plants, forest habitat and birds' biodiversity.

Table 3: Proposed Crows Management Method Plan.

This study is not impervious to some limitations as well as challenges stemming from a lack of continues previous records and the complexity topography of the areas. Obtaining records and status of the crows is not a straightforward process, which explains why the environment authority in the Sultanate of Oman will continue to examine future studies in terms of the information related to the population's trends, crows' tracking, breeding, and non-breeding season not only along the coastal areas, but also across forest mountain ranges.

Conclusion

This study identified key areas where Indian House Crows are prevalent in the Dhofar Governorate, located in the southern part of the Sultanate of Oman. According to the findings, House Crows are

most densely distributed in Salalah, followed by the fishing ports of Taqah and Mirbat. Sadah exhibited the lowest numbers, likely due to its sparse human population. As per the findings of this study, crows are mainly primarily linked to human population size and fish ports. It was also observed that Crows tend to nest near human settlements in order to gain food, protection, and survival. This research provides valuable insights into the ongoing environmental changes in Oman, aimed at safeguarding local species and promoting sustainable resource management practices. Given the challenges in obtaining comprehensive data on House Crows and their behaviors, the environment authority plans to conduct future studies focusing on trends in population dynamics, tracking movements of crows, and investigating their breeding and non-breeding seasons. These efforts are crucial for developing informed management strategies to effectively mitigate the impacts of House Crows in the region.

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