# Eradication of the house crow from Socotra Island, Yemen

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**Abstract** The house crow (*Corvus splendens*) is one the world's most invasive bird species, affecting more than 25 nations throughout the Indian Ocean, Arabian Peninsula and South East Asia. It can create problems for the natural biodiversity of regions, as well as impacting upon human health, tourism, infrastructure, and general development. The first house crows arrived on Socotra Island, Republic of Yemen, in 1995/96, having been transported unintentionally from mainland Yemen by ship. Socotra Island is a UNESCO world heritage site and its ecosystem includes a large number of endemic species. For more than a decade, ongoing management on the island by bounty payments kept numbers of the breeding population low, but did not remove it completely. The population of the last 13 birds was eradicated by shooting in April 2009, Management of other populations of this invasive species is recommended.

**Keywords:** *Corvus splendens*, chick collection, shooting, monitoring, regional cooperation, small populations, spread, bounty

## INTRODUCTION

The house crow (*Corvus splendens*) is native to India and parts of its neighbouring countries where it is closely associated with people (Ali 2002) and has some negative impacts on their communities. However, the effects of house crows are so significant in the 25 or more countries throughout Africa, the Middle East and South East Asia where the bird has been introduced (Ryall 1994, 1995, 2002), it is now regarded as one of the world's most invasive bird species (GISD 2010). Introduced house crows continue to spread across the region of their introduction (Nyari 2006) with negative effects on agriculture, tourism, human health, traffic, transport, and biodiversity (Ryall 1992b). House crows eat crops and damage orchards (Dhindsa *et al*. 1991; Feare and Watson 1990); disturb tourists and local citizens with their loud calls, as well as their heavy defecation and aggressive attacks when attempting to steal food (GISD 2010); transmit pathogens, which affect people and domestic animals (Al-Sallami 1991; Cooper 1996; Roy 1998); and also pose a bird strike risk to aeroplanes (Ryall 1992b). The crows are also responsible for the reduction or severe depletion of small reptiles and amphibians, birds and mammals, insects, fish and domestic animals (GISD 2010). Lack of data allows no quantification of such losses and disturbances. However, in the areas that are newly colonised by this bird species, the impact is believed to be high. In most of the affected countries, no control projects against the house crow are undertaken.

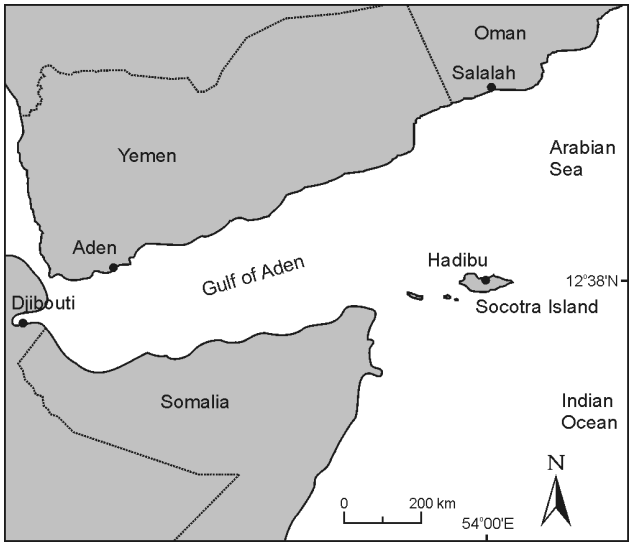


**Fig. 1** Location of the island of Socotra, Republic of Yemen, and other locations mentioned in the text.

This paper records the arrival, establishment, and measures used to control, and subsequently eradicate the house crow on Socotra Island. This work was managed by staff of the Socotra Environmental protection Agency (SEPA). There was no funding or action for detailed pre-eradication research or planning. Biosecurity measures for possible new house crow arrivals are not considered in this paper.

## PROJECT SITE

Socotra Island (3500 km$^2$), in the Republic of Yemen, is 380 km off its coast and 150 km from the horn of Africa (Fig. 1). The human population of 43,000 is not dense due to the remote location and desert environment.

The island has 65 % endemism of the approximately 900 species of plants and up to 90 % endemism of insects and reptiles (Unpubl. SEPA data). Socotra became a UNESCO World Heritage Site in 2007, which demonstrates the value of the island for the region's biodiversity but also its value for tourism. The island's terrestrial environment is threatened by uncontrolled development and its surrounding waters by illegal fishing, but invasive animals were not considered a threat for many years.

The house crow arrived on Socotra Island in 1995 or 1996 (Table 1), when one pair was thought to have travelled on a ship and then establish in the island's capital, Hadibu. This arrival was not unexpected, since mainland Yemen, especially the city of Aden, has well-established populations of house crows originating from founders released by the British colonists at the end of the 19th century. The spread of house crows by ship across the region often reported (Kinnear 1942; Jennings 2004; Ryall 2008), but despite the negative effects of the crows in Aden and on the mainland (Ash 1984), there was no attempt at port sites to prevent the species arriving and establishing on Socotra. Furthermore, there was no rapid response to eradicate the newly-arrived birds on Socotra.

**Table 1** Summation of dates and the population status of the house crow (*Corvus splendens*) on Socotra Island, Republic of Yemen.

| Date | Status/action |
|---|---|
| 1995/96 | Pair of birds arrive on a ship |
| 1998 | Bounty payments started |
| 2002/03 | Population reaches 23 breeding birds |
| 1998 - 2008 | More than 550 chicks/eggs removed |
| 2008 | Bounty payments stopped |
| April 2009 | 13 birds killed. Population eradicated |

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The birds settled in a valley planted with palms along the edge of Hadibu. The valley contains a shallow stream arising from the interior mountains and running into the sea in the north. The character of the area is rural, commonly with gardening and domestic animals in the backyards of houses. The stream has considerable garbage pollution along its banks, making it an ideal environment for commensal species like house crows.

The birds nested in tall palms next to houses where all resources needed by the birds were available. Without any natural enemies, the crow population increased, leading SEPA in 1998 to instigate a bounty system as a means of restricting the rate of expansion. Increasing amounts of money was paid to teenagers for climbing to the nests and removing the chicks and eggs. Over ten years, more than 550 chicks and eggs were removed making this an effective method of control that kept the numbers very low. However, the method was costly and did not achieve eradication. At its peak, the house crow colony on Socotra comprised 23 breeding birds (Omar Al-Saghier pers. comm.).

In 2008, when bounty payments were stopped, the house crow on Socotra Island had potential to increase unrestricted. Studies elsewhere indicated that a population of 100 crows could reach 2000 within four years (Ali 2003). Concern about the growing impact of the house crow on native bird species (e.g., Ryall 1992a) then led to the decision that eradication of the population was necessary.

During this period, eradication attempts of trapping by SEPA personnel and shooting by marksmen from the Yemeni army had not resulted in any bird being killed. It was recognised that no abilities for eradication existed on the island or within the country. The use of foreign expertise was the next step, and a cooperative project aiming for the rapid, successful eradication of the house crow from Socotra was founded by SEPA at the end of 2008 supported by an financial contribution of the Small Grant Scheme of the Global Environment Facility (SGP/GEF), Yemen. The crow population at this time was estimated as 12 birds.

## METHODS

This project was limited by financial constraints and visas were restricted to two weeks on the island by the foreign experts involved. All planning was through remote communication as neither of the two foreign individuals in the project team had been to Socotra so had no impression as to the exact situation. There are few comparable operations to eradicate extant populations of house crows and this limited previous experience to draw on when the operation was planned.

Poisoning with avicides like Starlicide (also called DRC1339, 3-chloro-ptoluidine hydrochloride) is the most commonly used technique to kill house crows in larger numbers on mainland Yemen (Jennings 1992). This method would have required more than the two weeks available and, due to the presence of large populations of two species of vultures, no poisoning was permitted.

Trapping would also have required more than two weeks. Also some of the birds were possibly trap-shy as a result of the failed trapping efforts by SEPA.

The option to shoot all of the birds was agreed to by all parties as the only available method. The shooting had to be by someone who was an experienced marksman and hunter, had worked on eradication projects for other species, and who knew how to apply techniques that would keep the house crows naïve about the aim of the project for as long as possible.

Three different firearms and appropriate ammunition were brought to Socotra. These were selected by the hunting expert based on years of experience of shooting crows in other parts of the world. The import of silenced .17 HMR and .22 R/F rifles, and a semi-automatic shotgun, were authorised by the Yemeni Interior Ministry.

The shooting was to be from a camouflaged window in an SEPA 4x4 Jeep. Senior SEPA staff were to be present at all times to guide the operation and talk to the public. The shooting team was also partially guided to locations by other observers. Occasional additional support from SEPA personnel was available.

## RESULTS

The eradication project was conducted between mid to end of April 2009 on the outskirts of Hadibu. The local community supported the activities passively by not interrupting, and actively by showing where house crows had been seen, heard, or were feeding, roosting, and nesting. Residents became quickly aware of the fact that foreigners with guns were driving around in their neighbourhood. In recognition of the traditional, conservative, Muslim way of living in Hadibu, and the presence of weapons in most households, the permanent presence of SEPA (author of this paper) in the project team secured the safety of the shooter and provided explanations for reasons behind the activities to the local population.

Shooting began three days after the team arrived on Socotra. The first gun used was the silenced .22 calibre rifle with which half of the known population (six birds) was killed in one afternoon.

The crows then started to become more cryptic and careful. Although not yet able to identify the shooter, observer, or the car as a threat to avoid, the crows became less obvious. The next three birds were shot on day two, using a silenced .17 rifle and high power ammunition, which allowed shooting from the already necessary longer range.

After this, the three remaining crows were shy and partially started to leave the area for another valley 2-3 km away. The birds avoided staying at a site once the presence of the observer or the jeep was noticed. In order to discourage this wary behaviour after just two days of direct persecution by shooting, a day of observation was used to reduce stress on the crows. This also allowed time to re-count the remaining birds and identify possible shooting locations for the coming days.

On day four of the shooting operation the shotgun was used. The loud report made when firing this gun meant it was a less desirable tool in an urban or village setting. The first bird shot was intercepted flying between the two valleys. The second crow of the day was shot whilst a local person was climbing a known nesting tree to remove nesting material and/or eggs. From previous experience within the project, it was known that the crows would attack any human within the proximity of their nest and so the project team used this method to attract a bird to the site.

The last known bird (no. 12) was shot in the early afternoon, after two hours observation and identification of any patterns in its erratic flying and nervous behaviour. By then, the observer within the team had clearly been identified as a threat and the last crow kept its distance. As the bird was using the same palm fronds as look out posts, it allowed the shooter to get in position under one tree. The bird was then purposely driven by the observer toward the particular palm, using the “repellence-reaction” of the crow toward the observer. It was then shot.

After more than 500 man-hours of monitoring on foot, in cars, and from rooftops of houses, no further crows were seen, heard, or reported. An appeal was also put out within the local community for any crow sightings and an increased bounty was offered for any information. Seven days after the last known bird was shot, and just as the team

was about to depart, a single crow was reported circling over the Hadibu Valley. SEPA personnel tried to find this bird's origin, as well as clarify its movement patterns. However they failed as the crow disappeared, returned two days later, then disappeared again. The specialist team therefore went back to shoot this last bird, which was seen as the most dangerous crow because its previous presence and origin were unknown as was the site to which it disappeared. There was a high likelihood that the bird was a single remaining nesting individual surviving in a neighbouring valley. After four days of observation and pursuit, the final bird (no. 13) was shot in Hadibu Valley, using magnum shotgun ammunition.

In total, after 15 days, 13 birds had been shot ending a 15 year old problem with the potential to become a major issue for the island's fauna and flora and people.

## DISCUSSION

The initial action to control this invasive species was instigated soon after its arrival on Socotra. The use of bounty payments did slow the increase of the population but rapidly became too costly.

It is unclear why the crow population declined from the 23 bird peak in 2002/03 to 13 birds in 2009. The bounty system would have been slowing recruitment but the death of 10 adults is higher than expected. Birds of prey may have been having an unexpected impact.

The spread of the house crow is well documented and the bird is known for its abilities to populate new territories and survive under a variety of sometimes unfavourable conditions (Lever 2006). The success of the Socotra Island eradication can only be guaranteed when there is a system for rapid response to new incursions of crows. Otherwise, reinvasion will become an increasing risk as populations of crows expand in neighbouring countries or the wider region (Ryall and Meier 2008). Increasing ship traffic will likely add to this risk, although for the moment, due to piracy in the Gulf of Aden, this threat has temporarily decreased.

The best way of securing the results achieved on Socotra is to extend control or eradication into other areas. If control, or preferably eradication, of known house crow populations was strongly pursued elsewhere within the region, a system of sites without crow populations will develop. This would not only demonstrate that house crow control and eradication is possible, but more importantly provide immediate protection to native species and peoples' livelihoods. The reduction of populations in the region would also minimise the risk of birds reaching new areas or reinvading those already cleared. Well planned and coordinated approaches would address the spread of house crows through prevention, which is the most cost effective method of dealing with invasive species. However, at the remaining sites it will still need direct control to continue overall population reduction.

For example, to secure the achievements on Socotra, a small population of house crows in the port city of Salalah in Oman should be eradicated since many ships depart from this port to Socotra. The eradication of this population would secure a "crow-free" buffer zone for 1600 km along the Yemeni/Omani coast, minimising the chance of new populations building up there and enabling realistic monitoring for a "no-crow" zone.

Across the Gulf of Aden, in Somaliland, and the Autonomous Region of Puntland, there are newly detected, yet small populations of house crows. Their eradication would be comparably easy to implement since the populations are just a few dozen birds and security is much more advanced on the sites than in the neighbouring, former Somalia.

Such activities will buy the time needed to take on the larger populations of house crow in Djibouti and Eritrea on the African coast, but especially those in Aden and mainland Yemen on the south of the Arabian Peninsula. Significant funding and a work force need to be assigned for those tasks and of course there will also need to be a secure working environment. Eradicating house crows from Aden will not be an easy task since the birds are well established. Nonetheless, if the crows were eradicated from this area, major populations of crows in the region would finally be removed, and other small scale operations in the regions would achieve success without facing a permanent and increasing risk of reinvasion.

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