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- Merwyn FERNANDES**, Wildlife Institute of India, P.O.Box 18, Chandrabani, Dehradun 248001, India. Email: fernandesmerwyn@gmail.com
- Jan Willem den BESTEN**, National Committee of IUCN in The Netherlands. Email: janwillem.denbesten@iucn.nl

Population and diet of migratory Common Starlings *Sturnus vulgaris* wintering in agricultural areas of Sialkot district, Pakistan

TARIQ MAHMOOD, SYED M. USMAN-UL-HASSAN, MUHAMMAD S. NADEEM & AMJAD R. KAYANI

Introduction

The Common Starling *Sturnus vulgaris* is one of the most successful and widespread bird species, having large populations on five different continents. It is native to Europe and Asia, but has also been successfully introduced to three other continents (Feare *et al.* 1992). Migratory populations that breed in Siberia and Turkestan use the Central Asian Flyway to winter in Pakistan and India (Roberts 1992, Champ & Riess 1999). Common Starlings visit Pakistan from late October to early April and occur throughout the country, except in high-altitude, snow-covered areas. The earliest arrival recorded in southern Punjab was on 27 September (Roberts 1992).

Common Starlings forage in flocks during winter (Coleman 1977, Tyler & Kannenberg 1980). They are omnivorous, consuming a wide range of invertebrate and plant material, but in winter, they rely more on plant material and can become a crop pest (Feare 1984). Winter diet varies regionally. In Australia, Higgins *et al.* (2006) described the Common Starling as omnivorous, consuming grain, fruit, seeds, nectar and garbage. In Alabama, USA, it usually digs up seeds in sown fields, sprouting garden vegetables and other flowering plants (Imhof 1962). In temperate Europe, wintering Common Starlings also take large numbers of invertebrates, primarily soil-dwelling crane-fly larvae (Tipulidae) found in grasslands (Feare 1984).

The global conservation status of Common Starling is Least Concern (BirdLife International 2013), but a sharp decline has been reported in its northern and western European populations during the past two decades. Reduced availability of food sources as a result of agricultural intensification is suspected to be one of the major reasons for its decline in Europe (Crick *et al.* 2002). Given its increasing conservation importance, it has become necessary to monitor Common Starling populations and investigate their ecology in wintering areas. No such studies have taken place in Pakistan, where Common Starling is also a protected species, listed under Schedule III of the Wildlife Legislation of Punjab province (Shafiq 2005). In this paper, we describe a study of a wintering population in an agricultural area of Sialkot district.

Methods

The current study was carried out in an agricultural ecosystem in Sialkot district, central Punjab province. The district covers 3,016 km² and comprises four tehsils (administrative units). Four 1 km² study sites were selected: Sialkot (Site I: 32.425°N 74.588°E; 790 m), Pasrur (Site II: 32.282°N 74.692°E; 757 m), Daska (Site III: 32.295°N 74.502°E; 707 m) and Sambrial (Site IV: 32.496°N 74.376°E; 748 m), representing one site from each tehsil. The study sites were surveyed monthly from 27 September 2010 to the end of May 2011.

The Common Starling population size was estimated using line transects (Burnham *et al.* 1980). Freshly killed Common Starlings were obtained from local hunters and their gizzard contents were analysed following the method of Coleman (1977). Twenty gizzard samples were analysed: five in each month from November 2010 to February 2011. Invertebrate prey items were identified and the number of individual invertebrates consumed was calculated based on remains such as head capsules, abdomens, paired elytra or wings (Hartley 1948).

Results

Common Starlings were first sighted (15–50 birds per flock) at Site III (Tehsil Daska) near canal banks and rice mills on 2 November 2010. Subsequently, starlings occupied feeding sites near irrigation water sources including nullahs, canals and subcanals. In the mornings (two to three hours after sunrise), flock size was typically 15–25 birds, occasionally reaching 50 birds per flock. Smaller flock sizes (8–15) were recorded around noon. In the evenings, large roosting flocks of 200–500 birds were recorded. Common Starlings were recorded in agricultural areas until 27 February 2011, but small numbers remained in urban areas until the first week of April 2011.

Estimated densities of Common Starling populations are summarised by month in Table 1. The highest population density was found at Site III (39 birds/km²) and the mean density was 26 ± 4 birds/km² (Table 1). Densities were significantly higher at Site III: Student's paired *t*-tests showed significant differences in numbers of birds between Sites I and III ($P < 0.01$; $t = -3.84$; $df = 3$) and between Site II and III ($P < 0.001$; $t = -8.42$; $df = 3$).

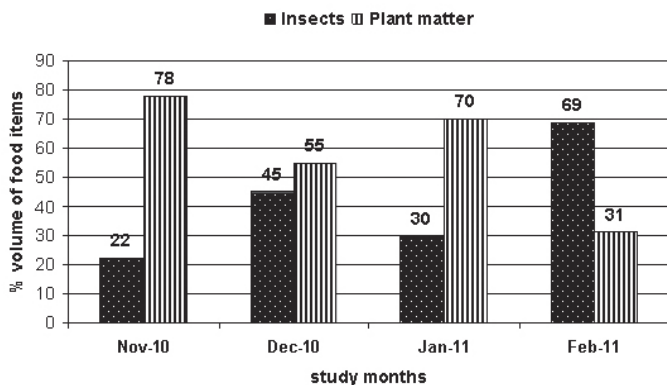
Common Starlings roosted in dense vegetation including bamboo, sugarcane fields and dense *Eucalyptus* trees. Large flocks congregated over the roost sites before entering them, just before sunset. Common Starlings generally started foraging an hour after sunrise and fed continuously until noon. While foraging, they dug up seeds and insects from the soft and wet soil by open-bill probing. About 30 to 45 minutes before sunset, they ceased foraging and flew back to their roosting sites. Starlings foraged on rice crops and also consumed sprouted wheat and lentil grains, spending roughly equal time in these crops. Brassica and *Trifolium* crops were visited less frequently than wheat and lentils. Among the vegetable crops, pea and potato fields were utilised. Starlings followed tractors ploughing fields to catch invertebrates. On rainy days, they foraged on uncultivated and unploughed fields.

Common Starling gizzards contained, on average, 42% invertebrates and 58% seeds and other plant matter by volume. There was a high incidence of adult insects in the gizzards and the groups found most frequently were Coleoptera (excluding weevils)

Table 1. Monthly densities of Common Starlings in each study site (estimated number/km² based on transect surveys).

Study sites	Nov 2010	Dec 2010	Jan 2011	Feb 2011	N	Density/km ²
Pasrur (Site I)	7	18	44	23	92	23.0
Daska (Site II)	20	28	38	12	98	24.5
Sambrial (Site III)	33	39	56	30	158	39.0
Sialkot (Site IV)	0	14	20	22	56	18.6
Total	60	99	158	87	404	105.6
Mean ± SE					101 ± 21.14	26.29

Figure 1. Monthly variation in diet of Common Starling in agro-ecosystem of district Sialkot during 2010/11.



(in 80% of gizzards), weevils (60%), Hymenoptera (55%) and Hemiptera (50%). No insect larvae were recorded, although unidentified insects were present in all samples. Seeds and other plant matter were present in all 20 gizzard samples and included wheat seedlings and wheat and rice grains. Small pieces of stone were also recovered from some gizzard samples. Plant matter dominated the diet from November to February, but in February the diet switched to insects (69% by volume) (Figure 1).

Discussion and conclusions

In many other parts of the world, wintering Common Starling is reported to be a crop pest (Imhof 1962, Tyler & Kannenberg 1980). We found evidence that Common Starlings also destroy newly planted crops. However, frequent consumption of insects that are harmful to crops, such as Hemiptera and weevils, may mean that Common Starlings are beneficial in the agricultural land of Sialkot district. The invertebrates comprising Common Starlings' diet in this study (Coleoptera, Hymenoptera and Hemiptera) have been reported in the diet of the species in Australia and New Zealand (Coleman 1974, Paton *et al.* 2005), but are less important in the European wintering range (Feare 1984). The observed variation in monthly diet composition can be explained partly by weather conditions. In severe weather during January 2011, the diet comprised 70% seeds and only 30% insects. However, in February 2011 the weather became mild and the proportion of insects in the diet increased to 69%.

Roberts (1992) reported that Common Starlings arrived in Punjab in late September and departed in the first week of March. The arrival date in this study was one month later, but the departure dates were the same. No other recent observations are available so we cannot confirm whether there is a trend for later arrival. The mean density of wintering Common Starlings in Sialkot (26.6 birds/km²) was similar to that on farmland in Great Britain (30 birds/km²) according to Robinson *et al.* (2001).

Data were also collected from expert local hunters about population trends of Common Starling in the study area. They considered that the Common Starling population had declined sharply in the preceding 6–8 years. The reason behind this decline

may be uncontrolled hunting for commercial purposes as starling meat dishes are marketed through local restaurants. The local hunters mainly captured starlings with nets at roosting and feeding sites. The high proportion of invertebrates in the diet suggests that food resources are still plentiful in Sialkot. In northern and western European populations, reduced availability of food as a result of agricultural intensification is suspected to be one of the major reasons for its decline (Crick *et al.* 2002). The use of fungicidal seed treatments prior to sowing crops could be another cause of population declines in the study area.

Illegal uncontrolled hunting of Common Starling may be the biggest threat to wintering populations in Pakistan. Strict implementation of wildlife laws is required. Further detailed studies are also needed to investigate the effects of pesticides and fungicides on populations of the Common Starling in its wintering areas.

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Tariq MAHMOOD, Department of Wildlife Management, PMAS Arid Agriculture University, Rawalpindi 46300, Pakistan. Email: tariqanjua75@uaar.edu.pk (corresponding author)

Syed M. USMAN-UL-HASSAN, Department of Wildlife Management, PMAS Arid Agriculture University, Rawalpindi 46300, Pakistan. Email: smuhassan@gmail.com

Muhammad S. NADEEM, Department of Zoology, PMAS Arid Agriculture University Rawalpindi, 46300 Pakistan. Email: sajidnm@uaar.edu.pk

Amjad R. KAYANI, Department of Zoology, PMAS Arid Agriculture University, Rawalpindi 46300, Pakistan. Email: ark120106@yahoo.com