

REVIEW ARTICLE

A Review of Behavior Research on the Genus *Acridotheres*

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ABSTRACT

Mynas are small terrestrial birds that belong the order Passeriformes, family Sturnidae and genus *Acridotheres* which comprises of eleven species. The IUCN has categorized eight species as Least Concern, two as Vulnerable and one as Endangered. Review of literature reveals that behavior research regarding partial aspects has been conducted only on *A. tristis* and *A. ginginianus* and there is no study on the foraging behavior, intra-specific and inter-specific interactions during foraging by *A. ginginianus*. Both species are gregarious, foraging as omnivores and ground feeders. Both species are important for agro ecosystems as agents of pollination, seed dispersal and an effective biocontrol agent against crop pests like- *Achaea janata*, the *Castor Semilooper*. There is a dire need to interpret and analyze the complete behavioral repertoires of all species of *Acridotheres* with help of modern behavior coding software's to establish ethograms, time-activity budgets and species-specific behaviors in order to identify deviations, their causes and appropriate behavior models for their conservation management.

Keywords: Behavior, *Acridotheres*, Myna, Ethology, Softwares

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INTRODUCTION

The order Passeriformes comprises of small terrestrial birds characterized by their feet, which are adapted for perching [23]. The two suborders are Tyranni and Passeri. Approximately 1250 species of Tyranni are thought to be more primitive and are sometimes referred to as "suboscines." The Passerines, also known as the "oscines" or songbirds, comprise of 4500 species [25].

Sturnidae is a family of medium-sized oscine birds which consists of 34 genera and 126 species. Commonly known as starlings, these birds are highly successful and adaptable. Several sturnids are predominantly open country species [39].

One genus of this family, *Acridotheres* means "grasshopper hunter," because it feeds on grass insects [3, 55]. Its common name "Mynah" or "Myna" is derived from the Hindi word *maina* that itself derives from the Sanskrit word *madana* which means joyous or delightful. It is also said to mean 'messenger of God' in Sanskrit [34]. Usually observed in large populations, [4] they are highly intelligent and adaptable birds, also capable of learning to avoid dangerous situations by observing the behavior of other species. They have a highly sophisticated communication system [45]. Table 1 depicts the IUCN Name, Common Name, Conservation Status and Status Updation Year of all species of *Acridotheres*.

Table 1 Species of the Genus *Acridotheres*

S.No.	IUCN Name	Common Name	Conservation Status	Updation Year
1.	<i>Acridotheres albocinctus</i>	Collared Myna	Least Concern (LC)	2017
2.	<i>Acridotheres burmannicus</i>	Burmese Myna	Least Concern (LC)	2016
3.	<i>Acridotheres cinereus</i>	Pale-bellied Myna	Vulnerable (VU)	2020
4.	<i>Acridotheres cristatellus</i>	Crested Myna	Least Concern (LC)	2016
5.	<i>Acridotheres fuscus</i>	Jungle Myna	Least Concern (LC)	2016

6.	<i>Acridotheres ginginianus</i>	Bank Myna	Least Concern (LC)	2018
7.	<i>Acridotheres grandis</i>	Great Myna	Least Concern (LC)	2016
8.	<i>Acridotheres javanicus</i>	White- vented Myna	Vulnerable (VU)	2020
9.	<i>Acridotheres leucocephalus</i>	Vinous-breasted Myna	Least Concern (LC)	2016
10.	<i>Acridotheres melanopterus</i>	Black-winged Myna	Endangered (EN)	2021
11.	<i>Acridotheres tristis</i>	Common Myna	Least Concern (LC)	2017

***Acridotheres albocinctus* (Collared Myna)**

The Collared Myna, also known as the Indian Myna, is a medium-sized bird 22-25 cm in length. It has a glossy slate-black body and grey-black head. The bill is orange-yellow, eyes are bluish and legs are yellow. It has an attractive white wing patch and a white tail tip. In young birds, the belly and throat are paler shades of brown [31]. It is native to South Asia, including India, Nepal, Bhutan, Bangladesh, and Sri Lanka. However, it has been introduced to many other parts of the world, including Australia, New Zealand and South Africa. The versatile Collared Myna exists in a range of locations, including forests, grasslands, urban areas and agricultural areas. In its native region, it is frequently observed in open areas with scattered trees and plants, such as parks and garden. However, it is found in sizeable flocks [31]. The omnivorous Collared Myna consumes a wide range of foods including insects, fruits, seeds and discarded human food [31,11].

***Acridotheres burmannicus* (Burmese Myna)**

The Burmese Myna is 21-24 cm in length. It has a brown-black body and purplish or wine head. The bill is dark yellow, eyes are slaty-black and legs are dark yellow. Wings are black to grey-brown with black tail tip. Younger Burmese Myna is dull with brown crown [31]. It is native to Southeast Asia, specifically Myanmar, Thailand, Cambodia and parts of Indo-China. It is found in a variety of habitats including forests, grasslands, gardens, lawns and agricultural areas [31]. Burmese Myna is omnivorous and predominantly ground feeder. It consume insects, fruits, seeds, flowering plants and human waste food [31, 12].

***Acridotheres cinereus* (Pale-bellied Myna)**

Pale-bellied Myna (*Acridotheres cinereus*) is 25-27cm in length. It has a grey-black body and dark black crown. The bill is yellow, iris is lemon yellow and legs are yellow. The wings are black and tail is brownish-black with broad white tips of the outer feathers [13, 31]. The Pale-bellied Myna (*Acridotheres cinereus*) is native to Southeast Asia and is found in Cambodia, Laos, Thailand, Vietnam and Myanmar. It inhabits open woodlands and grasslands. It is observed in paddy fields, wooded cultivated areas, trees, parks and gardens of urban areas [31]. It is a highly sociable bird and feeds on insects, fruits, seeds, rice, maize, pearl millet, wheat and flowering trees [31, 55].

***Acridotheres cristatellus* (Crested Myna)**

Crested Myna is also known as Chinese Crested Myna, Chinese Jungle Myna, Tufted Myna and Chinese Starling. It is a medium-sized bird with body length 24-26 cm. Body and head are black. The bill, eyes and legs are dull yellow. Wings are black and the tip of the tail is pale white. [14, 31]; 41]. The Crested Myna is native to East Asia, specifically China, Taiwan, Vietnam and Myanmar. It prefers to inhabit cultivated areas, parks, gardens, open country, near human habitations and near urban areas [31]. The Crested Myna is omnivorous and ground feeder. It feeds on insects, fruits, seeds, animal waste dumps and human waste food [31].

***Acridotheres fuscus* (Jungle Myna)**

The body length of Jungle Myna is almost 23 cm. It has a grey-brown body and black head. The beak, eyes and legs are all yellow. The wings and tail are brown and the white feather tips on the tail are less visible. The juveniles have a dark brown feathers coat [31, 55]. The native distribution of *A. fuscus* includes an important part of India, Pakistan, Thailand, Malaysia, Myanmar, Bhutan, Bangladesh and Nepal. In Fiji and Tokelau, it has been successfully introduced [31]. In general, disturbed environments like agricultural areas, grasslands and urban areas seem to be the preferred habitat. . It typically inhabits in flocks of 10–30 or more individuals or pairs [31, 55, 15]. Jungle Mynas are omnivorous and forage on the grounds, frequently in the company of other Myna species to find their primary sources of food, which are insects, fruits and seeds [31, 55, 33]. They feed on insects and nectar of flowering trees - *Salmalia*, *Erythrina*, *Bombax*, *Butea*, *Careya* and *Spathodea* [4]. Animal waste dumps, seeds, particularly cereal grains and food leftovers by humans are also sources of food for Jungle Mynas [31, 40, 33].

***Acridotheres ginginianus* (Bank Myna)**

The species name is based on the name given by Latham from a description by Gingi in 1782. There are several names associated with Bank Myna, some local names include Ganga Myna (Hindi), Gang Salik

(Bengali), Barad Myna (Bihar), Bardi Myna (Nepal), Lali (Sind), Daryla Myna (Uttar Pradesh) and Ghoda Kabar (Gujarati). The length is approximate 20-23cm. It is bluish-grey in body color with a black head. Beak, eyes and legs are deep orange and eye patches are light orange. The wing patches and tips of tail feathers are pinkish and white [22, 29]. Bank Myna is evolutionarily closest to the Common Myna [61]. The bird has been reported in planes of northern and central India from the Himalayan foothills, *terai* to a line from Mumbai to Balasore in Orissa, but not in peninsular India [3]. This species occurs in the Indian subcontinent from Bangladesh, Bhutan and Nepal through India west to Pakistan and there is an ancient record of the species in Southeastern Afghanistan [5]. The varied vegetative characteristics along with the Vishwamitri River and riparian zone have together influenced to increase the diversity of Bank Mynas [15-19, 12]. They are commonly seen feeding around railway stations, platforms, roadside hotels and food-stalls in cities [18]. Bank Mynas are omnivorous and predominantly ground feeders. They are adapted to live in the semi-urban environment and feed on garbage, grains, fruits, insects and some crop pests such as *Achaea janata* whose caterpillars feed on castor [53, 15, 31, 54]. They also feed on ripening crops such as sorghum, pearl millet, wheat and maize. They sometimes follow grazing animals picking up disturbed insects or even ticks on the animals [9]. Bank Myna builds its nest mostly in crevices of walls under bridges [44].

***Acridotheres grandis* (Great Myna)**

Great Myna is a medium-sized bird, measuring around 25cm in length. It has a brown body and black head. The beak is bright yellow-orange and eyes are dark reddish-brown. Legs are bright yellow-orange, wings are black with white patches [31]. The Great Myna is a native of South Asia, found throughout the Indian subcontinent and in China, Thailand, Cambodia, Sri Lanka, Pakistan, Nepal, Bhutan, Afghanistan and Myanmar. It is successfully introduced in Malaysia [31,12-19, 7]. It frequently inhabits urban areas, agricultural areas, gardens, parks and open forests in its natural habitat [31]. Great Mynas are sociable birds that frequently gather in sizeable flocks. They are omnivores and ground feeders. They feed on fruits, grains, seeds, nectar and insects. They have also been observed scavenging for food in cities [31].

***Acridotheres javanicus* (White-vented Myna)**

The White-vented Myna is also known as the Javan Myna. Body length is 21–23 cm. It has a black-brown body and black head. The bill is bright yellow, eye patches are lemon-yellow and legs are bright yellow. The wings are brown-black with white outer tail tips. The juveniles are brown [31, 14]. White-vented Myna (*Acridotheres javanicus*) is a successful invasive bird in Singapore. It is a native of Java and Bali but has been introduced in southern Peninsular Malaysia and Singapore [31, 60, 40-48]. It inhabits forests, urban and rural areas such as parks, gardens, cultivated areas and human residential areas [60]. It is omnivorous and ground feeder. It feeds on seeds, fruits, insects, nectar and food wastes by humans [31].

***Acridotheres leucocephalus* (Vinous-breasted Myna)**

The Vinous-breasted Myna is also known as the Red-vented Myna. It is a medium-sized bird, 25-27 cm in length. It has a brown-black plumage and dark brown head. The bill is bright yellow with yellow patches around its eyes. Legs are bright yellow and wings are dark grey-brown. [31]. It is native to Southeast Asia, particularly in Myanmar, Thailand, Laos, Cambodia and Vietnam. It is found in open habitats, including forests, grasslands, gardens and cultivated areas, especially well-watered short grass on lawns. It is omnivores and ground feeder. It feeds on insects and fruits, seeds [19, 31].

***Acridotheres melanopterus* (Black-winged Myna)**

The Black-winged Myna is also known as the Chestnut-tailed Starling. It is a medium-sized bird, measuring around 22-24 cm in length. It has a dark brown-black body and a glossy blue head. The bill is yellow, eyes are around pink and legs are yellow. Wings are black with white patches and tail is brown [31, 59]. The Black-Winged Myna is found in Southeast-Asia, including India, Nepal, Bangladesh, Myanmar, Thailand and Cambodia. It prefers various types of forest habitats, including tropical forests, subtropical forests and deciduous forests. It is found in agricultural areas, fruit farms, human residential areas, parks and gardens [31, 13]. It is omnivorous and ground feeder. It feeds on various insects, fruits and seeds [31].

***Acridotheres tristis* (Common Myna)**

Common Myna is also known as the Indian Myna or House Myna, around 25-26 cm in body length. It has a stocky chocolate dark brown-black body with a black head. Beak is yellow, eyes are yellow and legs are yellow. Wings are chocolate brown in color with white patches [48, 54, 31]. Throughout India and Central and Southern-Asia, the Common Myna is extensively dispersed. The bird is indigenous to Bangladesh, Bhutan, China, India, Iran, Malaysia, Myanmar, Nepal, Pakistan, Singapore, Sri Lanka and Thailand [31]. It is an introduced species in eastern Australia [47, 32]. It is spotted feeding in groups in grassland, cultivated areas, adjacent to human habitations, gardens, parks, rural and urban areas. There are typically observed in pairs and forage in groups in open spaces like cultivated fields [43, 44]. Common Myna is

omnivorous and ground feeder. It mostly consumes insects, although it also consumes small mammals, fruits, grains, cabbage leaves, seeds, nectar and discarded waste from human habitations. The nest of Common Myna is built on rooftops, holes in walls, trees and occasionally, the old nest of squirrels is adopted [55, 28, 44].

All species of the Genus *Acridotheres*, sexes are not distinguishable in the field and both male and female are same size [31, 35, 3, 23].

REVIEW OF LITERATURE

The genus *Acridotheres* has been studied only since the latter half of the 20th century, with little more than twenty publications. Most of these studies are ethological studies, whereas a few of them are studies on Mynas in captivity [1-3]. Very few aspects of the behaviors have been studied, which are mostly qualitative in nature and quantitative studies are scanty. The ethology accounts till date have been compiled as follows:

***Acridotheres ginginianus* (Bank Myna)**

Simwat and Sidhu [53] conducted a qualitative study on the development, nesting habits and feeding behavior of Bank Myna in Punjab, India. Thakor *et al.* [56] studied the diurnal activities of Bank Myna in winter season in Patan district, Gujarat. Thakor *et al.* [57] studied the Bank Myna diurnal activities during nesting period. Thakor [58] studied the feeding, locomotion, agonistic behavior, maintenance and vocalization of Bank Myna during the breeding season in Patan district of Gujarat. Dhandhukia and Patel [29] studied the safe nesting sites and nesting materials of Bank Myna in Junagadh district of Gujarat, India. They nested mostly in bridges and walls, but they preferred artificial wooden nests. Chudasama *et al.* [24] investigated the various heterogeneous communal roosting populations of Common Myna (*Acridotheres tristis*), Bank Myna (*Acridotheres ginginianus*) and Brahminy Myna (*Sturnia pagodarum*) in Bhavnagar, Gujarat.

***Acridotheres tristis* (Common Myna)**

Counsilman [27] analyzed the communal walking and roosting behavior of Common Myna throughout the year in New Zealand. Mahabal and Vaidya [43] studied the diurnal rhythms and seasonal variation in relation to the times of sunset and sunrise during roosting by Common Myna. Siddique *et al.* [52] reported the breeding behavior of Common Myna in Faisalabad. Breeding was observed from March through September. Newey [47] studied the foraging behavior of the Common Myna in relation to antipredator vigilance and group size in Australia. Common Mynas generally increased their food intake by increasing foraging effort, rather than decreasing vigilance behavior. Bates [8] recorded interactions and foraging behavior of two sympatric invasive species, the Common Myna and Red-Vented Bulbul. They investigated foraging habits, behavioral responses to the introduction of novel food stations, variations in foraging group size and species composition caused by natural processes and interactions between and within species. Ahmad and Sahi [2] analyzed food and feeding habits of the Common Myna that included a wide variety of insects, proving as very active bio-control agents in Jammu and Kashmir. Haythorpe *et al.* [36] studied the relative level of food aggression displayed by Common Myna when foraging with other bird species in suburban habitats and reported competitive aggression over food in Australia. Mohan [46] studied the effect of availability of food on aggression within and between pairs of Common Myna in French Polynesia. The results of the study showed that being in a group and having less quantity of food significantly increased aggression levels in Common Myna. McGiffin *et al.* [44] analyzed the tolerance of Common Mynas towards human approaches in urban and rural areas in Australia. Machovsky-Capuska *et al.* [42] investigated the macronutrient preferences of free-ranging urban population of Common Myna by using behavioral observations, field-based feeding experiments and the right-angled mixing triangle model (RMT) in Sydney, New South Wales, Australia. Federspiel *et al.* [32] compared the rural and urban Common Mynas regarding their foraging strategies and learning strategies in New South Wales, Australia. Peneaux *et al.* [49] suggested that high protein novel foods are consumed in higher quantities by Common Myna in Australia. Jaimipak *et al.* [38] analyzed the effect of distress, alarm and pre-flight calls on the behavior of Common Myna and White-vented Myna.

ECOLOGICAL IMPORTANCE

Positive aspects: Bank Myna is playing a vital role in maintaining the ecological cycle by accelerated seed dispersal, pollination and regulation of pest population [2]. Common Mynas are known as the farmer's friends because they protect crops by consuming insects and pests like- Grasshopper (*Locusta migratoria*) and Castor Semilooper (*Achaea janata*) [2, 54]. They consume large amounts of crop pests and protect the 'Kharif' cultivation from serious damage [53].

Negative aspects: Mynas are omnivores and could potentially compete with a large range of indigenous species for food and also can severely damage to the agriculture crops in the local community. Rapeseed (*Brassica napus*) which is of considerable economic importance has been heavily attacked by these birds [29, 51, 53].

Table 2 Behavior Sampling Methods, Devices & Softwares used till date to *Acridotheres ginginianus* studies

Researcher & Year	Methodology			
	Sampling Methods	Devices	Behavior Coding Softwares	Statistical Software's
Simwat and Sidhu [53]	Direct observation	-	-	-
Ahsan and Kabir [3]	Questionnaires	-	-	-
Thakor <i>et al.</i> [56]	Instantaneous sampling	-	-	-
Thakor <i>et al.</i> [57]	Focal sampling	-	-	-
Thakor [58]	Focal sampling	-	-	-
Dhandhukia and Patel [29]	Scan sampling	Binoculars (unspecified)	-	-
Chudasama <i>et al.</i> [24]	Direct count	Nikon Binoculars Nikon P620 Camera	-	-

Table 3 Behavior Sampling Methods, Devices & Softwares used till date for *Acridotheres tristis* studies

Researcher & Year	Methodology			
	Sampling Methods	Devices	Behavior Coding Softwares	Statistical Softwares
Counsilmam [27]	Unspecified	-	-	-
Mahabal and Vaidya [43]	Unspecified	-	-	-
Siddique <i>et al.</i> [52]	Unspecified	-	-	-
Newey [47]	Focal sampling	-	-	-
Federspiel <i>et al.</i> [32]	<i>Ad libitum</i> sampling	<ul style="list-style-type: none"> Garmin 72H GPS device) Binoculars (6x42) 	-	Med Associates PC-IV Software (Version 6)
Bates [8]	Focal sampling Scan sampling	<ul style="list-style-type: none"> Binoculars (8x42) 	-	JMP Software (Version 9)
Ahmad and Sahi [2]	Focal sampling	<ul style="list-style-type: none"> Binoculars (6x45) 	-	-
Dhandhukia and Patel [29]	Scan sampling	-	-	-
Haythorpe <i>et al.</i> [36]	Focal sampling	<ul style="list-style-type: none"> Camera (Unspecified) 	-	-
Mohan [46]	(Unspecified)	<ul style="list-style-type: none"> Nikon AW100 camera, Powerview Binoculars Olympus VN 5200PC Digital Voice Recorder 	-	JMP Software (Version 10)
McGiffin <i>et al.</i> [44]	Focal sampling Instantaneous sampling	-	-	Systat Software (Version 13)
Machovsky-Capuska <i>et al.</i> [42]	Unspecified	<ul style="list-style-type: none"> DVR Camera Nikon Binoculars 	Avidemux Software (Version 2.6)	-
Peneaux <i>et al.</i> [49]	<i>Ad libitum</i> sampling	-	-	R Software (Version 3.1.1)
Jaimipak <i>et al.</i> [38]	Unspecified	-	-	Raven Pro Software (Version 1.5)

CONCLUSION

Studies on behavior are important to understand community structure, resource use pattern and co-existence in a particular habitat. Review of literature reveals that behavior research regarding partial aspects has been conducted only on *A. tristis* and *A. ginginianus*. Moreover, there is no study on the foraging behavior, intra-specific and inter-specific interactions during foraging by *A. ginginianus*. The rest of the nine species have been largely ignored as there is no research paper regarding their ethology or experimental studies on their behavior, although *Acridotheres cinereus* and *Acridotheres javanicus* are Vulnerable and *Acridotheres melanopterus* is Endangered. Detailed analysis of all behaviors including communication, social cognition and vocalizations is fundamental to the conservation management strategies of a species. There is a dire need to interpret and analyze the complete behavioral repertoires of all species of *Acridotheres* with help of modern behavior coding software's in order to establish ethograms, time-activity budgets and species-specific behaviors in order to identify deviations, their causes and appropriate behavior models for their conservation management.

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