International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 5.46 Volume 7, Issue 6, June 2020
Website- www.aarf.asia, Email : editor@aarf.asia , editoraarf@gmail.com

Present Scenario of House Sparrow Breeding in Human Landscape in Thar Desert, Bikaner, Rajasthan

Priyanka Jangeed[1], Mamta Sharma[2,] Anil Kumar Chhangani [1]

[1]Department of Environment Science, MGS University, Bikaner 334004, Rajasthan.
[2]Department of Zoology, Raj Rishi Govt. Autonomous College, Alwar 301001, Rajasthan

Abstract:
Birds, one of the links of food chain in sustainable ecosystem & are among the best monitors of environment to evaluate the environmental changes throughout the history as bio monitors. House sparrows have lived around humans for centuries. They are closely associated with people and their building. Look for them on cities, towns, suburbs, taking handouts in parks and zoos, or cheeping from a perch on your roof or trees in your yard. House sparrow like areas that modified by humans, including farms, residential, and urban areas. House sparrows are absent from undisturbed forests, grasslands, and extensive woodlands. The house sparrow is a stout, stocky sparrow, with shorter legs and a thicker bill then indigenous American sparrow. House sparrow tends to forage for food on the ground, using a hopping movement when not in flight. Their flight is direct, with continued flapping and no periods of gliding. House sparrow aggressively protects a small territory just around their nesting site. The house sparrow (passer domesticus) is traditionally associated with human habitation. However, the species has undergone dramatic decline in many urban areas in north-western Europe. There are many theories as to why the decline has occurred, but the lack of data on house sparrow number prior to their decline has hampered efforts to investigate these theories in detail. This review summarizes the demographic changes in urban house sparrow population since the 1970s, & considers evidence that the current population & distribution may reflect changes in urban habitats cause by socioeconomic change. The timing of the decline in urban areas and the rural populations are relatively isolated from each other, & that the urban population decline is not a result of decreased immigration from farmland areas as a result of agricultural intensification. Evidence is mounting that, within urban landscapes, house sparrows appear to be more prevalent in areas with a relatively low human socioeconomic status. Here, we present evidence to suggest that sparrow may have disappeared predominantly from more affluent areas, & that these areas are more have undergone changes to habitat structure. Also notice how these changes in habitat could influence sparrow population via impact on nesting success, foraging & predation risk.

Key Words: house sparrow, urban area, decline, habitat, population

Introduction:

The house sparrow (passer domesticus) is a small passerine bird widely distributed across old world countries in the northern hemisphere and is now also commonly found in several other countries, both in the northern and southern hemisphere, beyond its native range. The species has been on a steady decline throughout its native range and population have reduced to half or less in many of its native ranges (Gover Mistry *et al*, 2013). House sparrow have been the considered as an indicator species of inhabited areas. Studies showed that depressed abundance of various bird species in most parts of the world today, especially in urban areas, is a particular concern as many cities are growing rapidly both in areas and population. The non-migratory sparrows are widely distributed in the Indian subcontinent and occur worldwide (Rajasekhara and Venkatesha, 2008). In 1958, The dictator of communist China, Mao Tse Tung issued an order to devastate sparrows. He started a campaign, which is known as "The Four Pests Campaign". Under this cleanliness drive, orders for the holocaust of rats, mosquitoes, flies and sparrows were issued. But the biggest thing is that the charge was laid on the sparrow that is eats excessive crops.

Female: Females neither poses black on head or throat, nor a grey crown; upperparts are streaked with brown. (Dandapat, 2014). Females are a plain buffy-brown overall with dingy gray-brown underparts. Their backs are noticeably striped with buff, black and brown. (www.allaboutbirds.org).

Male: Male has smart black bibs, white cheeks, bright rufous napes, and stunningly patterned wings with brilliant buffs and browns. Under parts are pale pearly-grey. Females are plain brown with cute face and lighter eyebrow. Their backs are noticeably striped with buff, black, and brown. (Lipton, 2015). Males are characterized by grey crown, cheeks and underparts, black on the throat, upper breast & between the bill & eyes. During summer the bill is blue-black, and the legs are brown. The plumage is dulled by pale edging in winter, and the bill is yellowish brown(Dandapat, 2014).

Juveniles: Juveniles are deeper brown, and the beak is dull yellow. Calls a slightly metallic ''cheep", "chirrup". Song a series of cheeps, shrill monotonous (Dandapat, 2014).

Distribution: The house sparrow is distributed worldwide (excluding the poles). It is native to Eurasia and North Africa. It was introduced into S. Africa, South America, Australia, New Zealand, and America. Its introduction into North America occurred in 1851, when a group of 100 birds from England was released in Brooklyn, New York (Roof, 2001).

The house sparrow is, possibly, the most widely distributed wild bird in the world. It is native range is Europe and much of Asia, but it has been introduced, both accidently and on purpose, into North America, S. America, Australia, New Zealand, Africa and numerous, scattered islands. It thrives almost anywhere that there are people. The only gaps in its nearly worldwide distribution are extreme tropical regions, deep forest and extensive deserts.

Introductions of house sparrow into North America during the middle to late 1800 have occurred at multiple locations over a 25- or 30-year time period. Dozens and hundreds and even thousands of birds were transported from Europe and released into urban and rural sites. The rationale behind this widespread importation and released is a bit murky. Control of insect pests on shade trees, accelerated breakdown of street and road deposited horse manure,

nostalgia for familiar, old-world species, or just a contagious mania concerning sparrows have all been suggested. The house sparrow's ability to nest in cavities and protected spaces of almost any human foods, to distribute themselves rapidly through new environments, and to produce huge numbers of offspring in a single mating season have all contributed to the species' explosive population growth in almost every area to which they have been introduced.

The house sparrow is a confirmed hanger on to man ever since human habitation started depending on agriculture. it has even been mentioned in most of our mythologies and folklores, along with the common crow, eagles and other such birds, which used to exist in close proximity to human dwellings. (Ragoorao, 1998). In order to assess the population of this species in the National Capital Territory of Delhi-India, this study was conducted during June-August in 2007. Twenty-eight Fixed-Radius Point Count stations were established in 5 habitat types viz.

i. High-density urban area
ii. Medium-density urban area
iii. Low-density urban area
iv. Agriculture area
v. Forest area, within the study area.

The house sparrow is showing population decreasing in many parts of Europe, with recent declines being particularly severe in urban areas. To date, relatively little is known about the species' habitat associations within urbanized landscapes (Chamberlain, *et al* 2007) . We report here an investigation of the habitat associations of house sparrow using a survey of 1223 stratified randomly selected 500500-m squares within urbanized landscape of the UK, defined as at least 25% 'human cover'. The density of chirping male house sparrow (passer domesticus) and of all house sparrow were analyzed separately to obtain insights into breeding habitat requirements and general habitat associations, respectively. Multi-model interference showed that residential areas as houses, farms, flats; allotments (areas used for small-scale horticulture) & farm building were key predictors of house sparrow density and chirping male density. A pattern that appears in some city population is that house sparrows are most abundant & population decline are lower in socially deprived areas. Separate analyses on landscape of differing human cover showed similar results. Within residential areas, the increase of house sparrow (passer domesticus) density with their habitat area (on a long scale) was approximately threefold greater when private gardens were present than when they were absent. The model predicted a rapid decline in house sparrow abundance when only a small area of private gardens is converted to continuous housing. Allotments & residential area with parks are likely to be under pressure due to increased demand for housing, specifically from the infilling of green space within urban areas. It would seem to be imperative that any action plan to protect urban little house sparrow population should include specific protection of such key habitats.

The house sparrow belongs to the family passeridae so it is called passer domesticus. It is the most abundant bird in India. Recently, several studies have reported the decline of the house sparrow population because of habitat destruction. The highly adaptable habitat of house sparrow is urban, suburban, and agriculture in order to access the population of this species in Kupwara city of Jammu Kashmir, this study was conducted from April-June 2017. Three sampling sites were established during the study viz. hospital road, forest area, and DC office road. The result shows that house sparrows are abundant near the hospital road as compare to

other sites due to the presence of old type of stone building which makes them nest in. Different type of plantation and green spaces is might be another reason. Conservation awareness programs and long-term monitoring with the involvement of local people may be a fruitful approach for maintaining the population in the study area. Therefore, there is a dire need for continues studies in Kupwara city in Jammu Kashmir to known the real status of this species & other biodiversity of this area as well. Similar finding was reported by Neff,2011, The number of sparrows is found in nearly every habitat expect dense forest, follow lands, alpine and desert environments & it prefers human-altered habitats, particularly farm areas (Bhat, and Chauhan, 2020).

Study area: With changing urbanization pattern & architectural style, the house sparrow is rapidly losing its nesting ground leading to a drastic decline in its population. We studied the sparrow nesting population in Bikaner city in Rajasthan, India.

Bikaner is a city in the northwest part of the state of Rajasthan in northern India. It is located 330 km northwest of the state capital, Jaipur. Bikaner city is the administrative headquarters of Bikaner district & Bikaner division. It was formerly the capital of princely state of Bikaner. The city was founded by Rajput Rao Bika in 1486 & from its small origins it has developed in to the fifth largest city in Rajasthan. The Ganges canal, completed in 1928, & the Indira Gandhi canal, completed in 1987.

Climate: Bikaner city is situated in the middle of the Thar desert of Rajasthan & has a hot desert climate (Koppen climate classification BWh) With very little rainfall & extreme temperature. In summer, Temperature can exceed 50^{o} C, and during the winter they may dip below freezing. According to meteorological department of India, there are two seasons monsoon (June to September) and winter (October to February). The climate in Bikaner is characterized by significant variations in temperature. In the summer season it is very hot when the temperatures lie in the range of 28-45^{o} C (82.4-119.3^{o} F). in the winter, it is fairly cold with temperatures lying in the range of 5-23.2^{o} C (941.0-73.8^{o} F). Annual rainfall is in the range of 260-440 mm (10-17 inch).

Due to increasing the trend of urbanization & industrialization, there are fair changes of environmental pollution. Throughout the world, interest in the quality of ground water which is degraded by human activities, over exploitation, over pumping & percolation of effluents, sewage from factories & due to geological changes, becomes very important to access the groundwater quality.As of the 2011 census of India the population of Bikaner city was 644,406 placing it in the top 70 major cities of India and 5th Rajasthan. I select the city area 'GINANI' and MGSU, DPES (Department of environmental science). for comparative study about nesting population. City area has mor human interference while DPES have very less human interference.

City area GinaniMGSU, campus

Figure1: Study area in Bikaner

Herds of cattle, eg. Cow (*Bos indicus*) and Buffalo (*Bus bubalus*) and of Sheep (*Oris orienes*), Goat (*Capra hircus*) and Camel (*Camelus domesticus*), are the principal livestock which is reared and maintained by the cultivators as their subsidiary occupation. Other common mammals are: Desert Gerbil (*Merioneshurrianae*), House Rat (*Rattuarattusrufescens*) and Five-stripped Squirrel (*Funambuluspennantii*) as diurnal rodents; and Indian Gerbil (*Tatera indica*) and Indian Crested Porcupine (*Hystrix indica*) as the nocturnal rodents. The nocturnal lagomorphs, Hare (*Lepus nigicollis*) is widespread. Among the insectivores are: Little Shrew (*Suncusstolickzkanus*), Long-eared Hedgehog (*Hemiechinusauritus*) and Indian Hedgehog (*Paraechinusmicropusmicropus*). The common flying mammals include Fruit Bat (*Pteropus giganteus*) and Rat-tailed Bat (*Rhinopomahardwickii*) living in the tunnels, Deserted building, gardens, etc. The Feral Dog (*Canis familiaris*) is the most common predator in the CPR. The former is found in virtually all the habitats. Other carnivores, e.g., Fox (*Vulpes bengalensis*), Wolf (*Canis lupus*), Jackal (*Canis aureus*) and Jungle Cat (*Felis chaus*) are also common. Common herbivores are: Chinkara (*Ganzella gazelle bennettii*), Blackbuck (*Antelope cervicapra*) and Nilgai (*Boselaphustragocamelus*). A total of 36 observed mammalian species with the name of family are list in table 2, of which 11 species are listed in the schedule-I of Indian wildlife act 1972.

Table 1: List of mammalian Fauna observed in the study area

S. NO.	COMMON NAME	SCIENTIFIC NAME	STATUS
1	Blue bull	*Boselaphustragocamelus*	Least concern
2	Chinkara	*Gazella bennettii*	Least concern
3	Wild boor	*Sus sacrofadomesticus*	Least concern
4	Desert hare	*Lepus nigricollis*	Least concern
5	Desert fox	*Vulpes vulpes*	Least concern
6	Desert cat	*Felis-sylvestris ornata*	Fed
7	Indian desert gerbil	*Tatera indica*	Least concern
8	Indian grey mongoose	*Herpestesjavanicus*	Least concern
9	Indian hedgehog	*paraechinusmicropus*	Least concern
10	Rhesus monkey	*Macaca mulatta*	Threatened
11	Indian Fox	*Vulpes bengalensis*	Least concern
12	Indian desert jird	*Merioneshurrianae*	Least concern
13	Five-striped squirrel	*Funambuluspennantii*	Least concern
14	Jungle cat	*Felis chaus*	Threatened
15	Indian palm civet cat	*Viverricula indica*	Least concern
16	Jackal	*Canis aureus*	Least concern

Table 2: List of Avian Fauna observed in the study area

S. No.	Common Name	Scientific Name	Conservation Status
1	House Sparrow	*Passer domesticus*	Least concern
2	Red collared dove	*Streptopeliatranquebaria*	Least concern
3	Laughing dove	*Streptopeliasengalensis*	Least concern
4	Green bee eater	*Meropsorientalis*	Least concern
5	Red vented bulbul	*Pycnonotuscafer*	Least concern
6	White chicked bulbul	*Pycnonotusleucotis*	Least concern
7	Eurasian collared dove	*Streptopeliadecaocto*	Least concern
8	Indian koel	*Eudynamysscolopaceus*	Least concern
9	Red watteled bulbul	*Vanellus indicus*	Least concern
10	Red napped ibis	*Pseudibispopillosa*	Vulnerable
11	Lesser whiteroat	*Sylvia curruca*	Least concern
12	Common myna	*Acridotheres thristis*	Least concern
13	Laggar Falcon	*Falco cherrug*	Least concern
14	Tawny eagle	*Aquila rapax*	Near threated
15	Common peigon	*Columba livia*	Least concern
16	House crow	*Corvus splendens*	Least concern
17	Common babbler	*Turdoides caudate*	Least concern
18	Yellow eyed babbler	*Chrysommasinense*	Least concern
19	Large grey babbler	*Turdoidesmalcolmi*	Least concern
20	Chestnut sandgrouse	*Pteroclesexustus*	Least concern
21	Indian courser	*Cursoriuscoromandelicus*	Vulnerable

22	Indian bush lark	*Mirofraerythroptera*	Least concern
23	Ashycrowned sparrow lark	*Eremopterix griseus*	Least concern
24	Rufous-tailed lark	*Ammomanesphoenicura*	Least concern
25	Crested lark	*Galerida cristata*	Least concern
26	Oriental skylark	*Alauda gulgula*	Least concern
27	Himalayan griffon vulture	*Gyps himalayansis*	Near threated
28	Indian vulture	*Gyps indicus*	threated
29	Indian roller	*Coracias benghalensis*	Least concern
30	Eurasian eagle	*Bubo bubo*	Least concern
31	Greater spotted eagle	*Aquila clanga*	Threated
32	Steppe eagle	*Aquila nipalensis*	Near threated
33	Spotted owlet	*Athene brama*	Threated
34	Rock piegon	*Egyption hieroglyphics*	Least concern
35	Jungle crow	*Corvus (macrorhynchos) culminates*	Least concern
36	Indian parrot	*Psittaculakramerimanillensis*	Least concern
37	White eyed-buzzard	*Butasturteessa*	Least concern
38	Common wood shrike	*Tephrodornispondicerianus*	Least concern
39	Common chiffchaff	*Phylloscopuscollybita*	Least concern
40	Asian desert warbler	*Sylvia nana*	Least concern
41	Yellow-headed wagtail	*Motacillacitreolla*	Least concern
42	Ashy-crowned sparrow lark	*Eremopterix griseus*	Least concern
43	Paddyfield pipit	*Anthus rufulus*	Least concern
44	Tawny pipis	*Anthus campestris*	Least concern
45	Common sandpiper	*Actitis hypoleucos*	Least concern

Table 3: List of reptile fauna observed in the study area

S. No.	Common name	Scientific name	Status
1	Desert monitor lizard	*Varanus griseus*	vulnerable
2	Spiny tailed lizard	*Uromastryxhandwickii*	vulnerable
3	Sindh sand gecko	*Crossobamonorientalis*	Least concern
4	Toed agama	*Phyrnocephaluseuptilopus*	Least concern
5	House gecko	*Hemidectylusflaviviridis*	Least concern
6	Common indian skink	*Mabuyacarinata*	Least concern
7	Common indian toed	*Bufo melanosticus*	Least concern
8	Snake skink	*Lygosoma punctatus*	Least concern
9	Cobra	*Naja naja*	Least concern
10	Russell viper	*Viperarusselli*	Least concern

Bikaner district is rich in avian faunal diversity. The more common and familiar ones among the small to medium-sized species are: Blue rock pigeon (*Columba livia*), House sparrow (*Passer domesticus*), Common crow (*Corvus splendens*), Jungle crow (*Corvus macrorhynchos*), Common babbler (*Turdoidescaudatus*), Red-vented bulbul (*Pycnonotuscafer*), Tailor bird (*Orthotomussutorius*), Maina (*Acridotheres tristis*), Rufus woodpecker (*Celeusbrachyurus*), Parrot (*Psittaculaeupatria*), Bee-eater (*Meropsorientalis*)

and Red-wattled lapwing (*Vanellus indicus*). Among larger common birds are: Peacock (*Pavo cristatus*), Red-headed vulture (*Sarcogyps calvus*), Cinereous vulture (*Aegypius monachus*), Egyptian vulture (*Neophron percnopterus*), Eurasian griffon (*Gyps fulvus*) and Himalayan griffon (*Gyps himalayensis*), and Kite (*Milvus migrans*). A few resident game birds like Great Indian busterd (*Choriotisnigriceps*), Gray partridge (*Francolinuspondicerianus*) and Common Sandgrouse (*Pteroclesexustus*) are also found. Some aquatic birds visiting ponds and lakes are: spoonbill (*Platalealucorodia*), Common teal (*Anas crecca*), Painted stroke (*Ibis leucocephala*), Little egret (*Egrettagarazetta*) and Sarus cranes (*Grus antigone*). A total 39 species of reptiles and amphibians listed with the name of family in table 4, of which four species are listed in the schedule-I of Indian wildlife act 1972. The more common reptiles are: Cobra (*Naja naja*), Viper (*Echiscarinata*), Indian sand boa (*Eryx johnii*), Monitor (*Varanus griseus*); and lizards: Calotes (*Calotes versicolor*), House lizard (*Hemidactylus flaviviridis*) and others such as *Agama minor* and 'Skink' (*Mabuyaaurata*).

Methodology:

This is evidenced by species richness, genetic variation and biological diversity, which exist in Thar. The Thar Desert is productive in so far for its topography, physoigraphy and biota are concerned. Keeping this in view, it is important to record the plant and animal taxa available in the study area. Listing of all the plants and animals encountered in the different parts of study area shall be attempted after conformed identification. Field surveys will be carried out in three different seasons (pre-monsoon, monsoon and post-monsoon) for one year. The methodology, which will be adopted during these field surveys to cover the different faunal species or group of animals mentioned in the objective section , are described below The co-ordinates of each sighting will be recorded with the help of Global Positioning System (GPS). The areas used by animals for resting will also be marked on the maps and vegetation parameters of such sites will be recorded later after the animal have moved out of these areas. Attempts will be made prepare inventory of the flora and fauna in the study area after confirmation based on Menon, (2003); Prater, (1965); Grewal, et.al. (1995); Kazmierczak, (2000); Bhandari, (1990) and Danial, (2002). If possible, some selected animals or group of animals will be selected and data on habitat usage, feeding behavior, interaspecific relationship, etc. will be collected by scene and ad libitum sampling method (Altmann, 1974). Mainly I collect door to door survey data in my study area at Maharaja Ganga Singh University campus and Ginani which is in city and an area with large human interference. Collection of indirect evidences: Animal droppings or other body parts (like quills, bones, feathers, etc.) will be collected for identification. Attempts will be made to locate burrows, dens, shelter, etc. Randomly selected transact survey in different types of micro habitats. Photography of selected flora and fauna in the study area, threatened plants and animals as per the Indian wildlife act 1972 with the help of cameras. The co-ordinates of each sighting will be recorded with the help of Global Positioning System (GPS). The areas used by animals for resting will also be marked on the maps and vegetation parameters of such sites will be recorded later after the animal have moved out of these areas.

Observation and Results:

The present preliminary study conducted in MGSU and GINANI Bikaner city area. I was trying to identify causes of the urban house sparrow population decline. we have separated variation between localities into study site and nest site effects, gaining insight into the contribution of microhabitat effects to overall variation in breeding ecology. House sparrow nests in holes of house especially old traditional building, under construction building & other

structures such as house windows, grills, streetlights, traffic lights. sometime house sparrow-built nest in trees, like babul (*Acacia Nilotica*), khejari (*Prosopis cineraria*), Ker (*Capparis decidua*) and Ber (*Ziziphus nummularia*) in the study area. Sparrow like thorny trees like jamun (*syzygiumcumini*), Nimbu (*Citrus*), kaner (*Cascabelathevetia*), Amrud (*Psidium guajava*) because that are safer and easier to hide themselves from predators. Sparrows also roosting in these thorny threes and their nests. AS shown in Fig. 1.9

When sparrow couple starting to make nest, they have a competition to other sparrows or they fight for the place and nest, and the sparrow repulse the other intruder sparrows. In our observation we find female sparrows try to intrude in nests. Then the owner sparrow fights with intruders and repulse them.

Aggressive Behavior


Roosting of sparrow

House sparrow nests are made of coarse dried vegetation, often stuffed into the hole until it's nearly filled. The birds then use finer material, including feathers, string, and paper, for the lining. House sparrow build their nest basically as a Bowl shape and then sparrow lift it up and make a round shape and create a barrier to other predators.

House sparrows make their nest in the cavity of buildings and other structures like streetlights, gas-station roofs, signs, and the overhanging fixtures that hold traffic lights. they sometimes build nests in vines climbing the walls of buildings. House sparrows are strong competitors for nest boxes, too, at times displacing the species the nest box was intended for, such as bluebirds and tree swallows. House sparrows' nest in holes in trees somewhat less often. (www.allaboutbirds.org)

House sparrow nests are made of coarse dried vegetation, often stuffed into the hole until it's nearly filled. The birds then use finer material, including feathers, string, and paper, for the lining. House sparrows sometimes build nests next to each other, and these neighboring nests can share walls. House sparrow often reuses their nests.

Clutch size: 1-8 eggs

No. of broods: 1-4 broods

Egg length: 0.8-0.9 in (2-2.2 cm)

Egg width: 0.6-0.6 in (1.4-1.6 cm)

Incubation period: 10-14 days

Egg description: Light white to greenish white or bluish white, usually spotted with grey or brown

Condition at hatching: Entirely naked upon hatching with bright pink skin, eyes closed, clumsy. (www.allaboutbirds.org)

Eggs typically hatch in 10-14 days and young house sparrow remain in the nest for another 15 days. (www.terminix.com)

- ★ Sparrows are disappeared in June mid to July after their first breeding season (January to May), and after it they are again noticed in the month August.

Table 4: Observation on Sparrows Activity

S.no.	Date	Activity
1	23/08/2020	Again noticed
2	26/08/2020	mating
3	27/08/2020	Noticed near old nests
4	29/08/2020	mating
5	30/08/2020	Collecting dry vegetation for preparation of nest
6	01/09/2020	Nest preparation
7	06/09/2020	Mating near nest
8	09/09/2020	Chick's chirping
9	11/09/2020	Male sparrow noticed to attack on insects
10	12/09/2020	Insect feed
11	14/09/2020	Insect feeding by male and female
12	23/09/2020	Chick chirping sound noticed in another nest
13	24/09/2020	Brown skinny chicks noticed
14	25/09/2020	Parent insect feeding
15	04/10/2020	Mature juvenile

Breeding and nesting of house sparrow

House sparrow sometimes builds nests next to each other. same this pattern we observe in MGSU campus. in a single window highest 4 no. of nests are found, and these neighboring nests can share walls. House sparrow often reuses their nests with some repairing and upkeep. As shown in Fig. 1.10. They are social, communal rooster and feeder. house sparrows are a common sight at bird feeders; you may also see them bathing in street-side pebbles or dust bathing on open ground, ruffling their feathers & flicking water or dust over themselves with similar motions. With the recent architect of housing, urbanization, industrialization and changes in land use pattern, House sparrow now seem to be decline across most of their range.

Table 5: Details of the nesting of house sparrow in study area of Bikaner city:

S. NO.	LOCATION			REMARK	NO. OF NESTS
	Elevation	North	East		
1	223 m	28° 01'45.9"	073°19'03.9"	Home thatch	1
2	220 m	28°01'43.5"	073°19'03.3"	Home thatch	2
3	225 m	28° 01'43.7"	073°19'03.0"	Near a wall & pipe	1
4	218 m	28°01'43.5"	073°19'03.4"	On the street pole	1
5	219 m	28°01'43.3"	073°19'05.1"	In a space in wall	1
6	225 m	28°01'42.9"	073°19'02.7"	In a space in wall	1
7	219 m	28°01'42.2"	073°19'04.0"	In a free space in wall	1
8	221 m	28°01'42.2"	073°19'03.2"	In a space in wall	3
9	217 m	28°01'41.7"	073°19'03.5"	In Home thatch	1
10	226 m	28°01'41.7"	073°19'04.4"	In home thatch	1

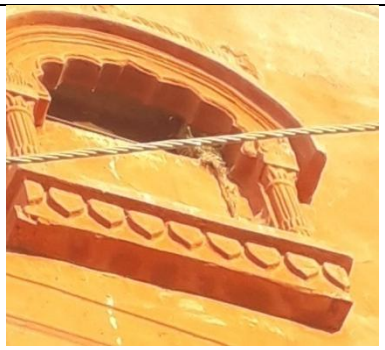
11	224 m	28°01’40.3”	073°19’03.3”	In home thatch	1
12	222 m	28°01’40.7”	073°19’05.2”	In home thatch	1
13	216 m	28°01’41.1”	073°19’05.3”	On a wall outside home	1
14	218 m	28°01’39.8”	073°19’04.0”	On street electric pole	1
15	220 m	28°01’39.5”	073°19’04.0”	In a vent outside the house	1
16	217 m	28°01’39.3”	073°19’05.1”	On a ziziphus tree	1
17	219 m	28°01’39.9”	073°19’04.2”	On an electric pole	1
18	219 m	28°01’37.5”	073°19’03.7”	In an electric meter	1
19	219 m	28°01’37.2”	073°19’04.1”	On thatch outside a shop	1
20	211 m	28°01’37.1”	073°19’03.8”	On Vent outside shop	1
21	206 m	28°01’36.8”	073°19’04.3”	On Wall outside a shop	1
22	217 m	28°01’36.7”	073°19’05.3”	On wires	1
23	219 m	28°01’40.8”	073°19’06.7”	In pipe	1
24	219 m	28°01’41.2”	073°19’07.0”	On a tree	1
25	224 m	28°01’41.4”	073°19’07.0”	On home thatch	1
26	232 m	28°01’40.9”	073°19’06.8”	On a tree	1
27	231 m	28°01’40.6”	073°19’07.0”	On a tree	1
28	224 m	28°01’41.2”	073°19’06.4”	In a window	1
29	218 m	28°01’39.9”	073°19’00.7”	On a ziziphus tree	1
30	221 m	28°01’40.0”	073°19’00.6”	In pipe	3
31	231 m	28°01’40.2”	073°19’02.6”	On tree	1
32	221 m	28°01’40.1”	073°19’02.8”	Vent outside house	3
33	226 m	28°01’40.2”	073°19’02.8”	free space in wall	1
34	228 m	28°01’39.7”	073°19’03.0”	Window outside house	3
35	227 m	28°01’ 39.6”	073°19’02.9”	Outside house in a window	4
36	227 m	28°01’39.6”	073°19’02.9”	In house thatch	1
37	225 m	28°01’40.8”	073°19’01.6”	On electric pole	1
				Grand total	**49**

Table 6: Details of the nesting of house sparrow in the MGSU campus area, Bikaner

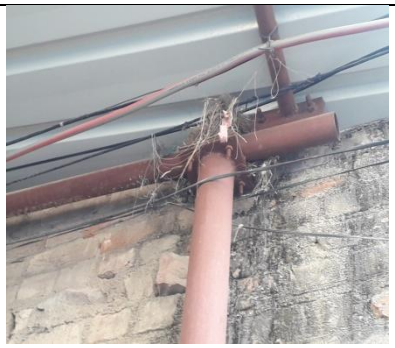
S. No.	LOCATION			NO. of NESTS	REMARK
	Elevation	North	East		
1	206 m	28°01’995”	073°15’512”	2	Microbiology store room, window no. 1,2,3
2				3	
3				2	
4	204 m	28°01’996”	073°15’503”	2	Env. Sci. classroom 1, window no. 1,2,3,4
5				3	
6				2	
7				2	
8	214 m	28°01’988”	073°15’504”	2	Yoga classroom 1, window no. 1,2
9				3	
10	214 m	28°01’984”	073°15’503”	1	Bathroom window
11	214 m	28°01’985”	073°15’510”	2	Store window
12				1	On a cavity in wall
13	217 m	28°01’984”	073°15’515”	1	Office 3 window 1,2
14				1	
15				2	Office 2 window

16				3	Office 1 window 1,2
17				-	
18	216 m	28°01’977”	073°15’522”	20	Auditorium windows no. 1,2,3,4,5,6,7,8,
19	217 m	28°01’982”	073°15’526”	3	Museum window 1,2,3,4
20				2	
21				3	
22				2	
23	224 m	28°01’982”	073°15’536”	2	Microbiology classroom 2, window 1,2
24				2	
25	219 m	28°01’979”	073°15’543”	2	Bathroom window
26	219 m	28°01’979”	073°15’543”	2	Env. Sci. class room 2, window 1,2
27				3	
28	207 m	28°01’992”	073°15’542”	3	Micro biology lab 1, window no. 1,2,3,4
29				4	
30				3	
31	209 m	28°01’994”	073°15’536”	3	Micro biology lab 2, window no. 1,2
32				1	
33	209 m	28°01’994”	073°15’537”	1	Yoga classroom 2 window
	Total			**87**	

Observed nests in Bikaner city area:



Nest no. 1,2



Nest no.3

Nest no. 4

Nest no. 5

Nest no. 6

Nest no. 7

Nest no. 8

Nest no. 9

Nest no.10

Nest no. 11,12,13

Nest no. 14

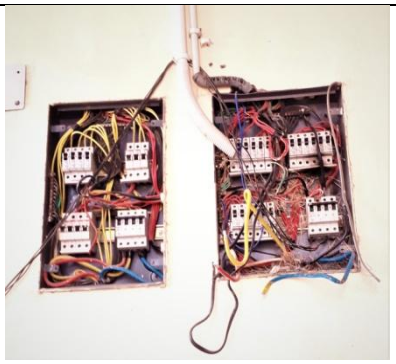
Nest no. 15

Nest sites observed in MGSU campus area:

Nest no. 1

Neat no. 2

Nest no. 3



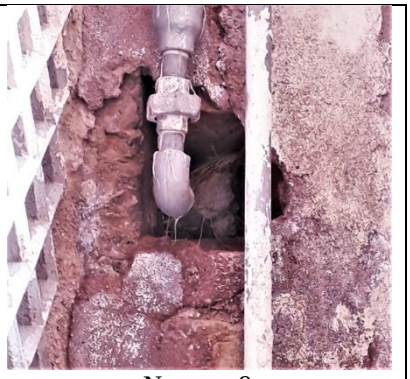
Nest no. 4

Nest no. 5

Nest no. 6

Nest no. 7

Nest no. 8



Nest no. 9

Nest no. 10

Nest no. 11

Nest no. 12

It was observed that some attacks of the predators like Dog, Cat, Brahmani myna, Bank myna, Snake, Hawk, Kite, Common crow, etc. on the house sparrow nests chicks as well as on juveniles and adults in both the city and MSG university campus area. The details of the observed predators are given in the following figure. In my observations we found that Brahmani myna attack on sparrows nest every noon to get their Eggs, and sparrows rarely attack on her, but mostly they chirping loudly and circling restless around the nest when brahmani myna attacks. Mostly Brahmani myna circling around the nest always and waiting to get a chance to attack. In another side bank myna also attack on sparrow nest during formation of nest, bank myna trough the dried vegetation and nest material away and try to spoil the nest. In city area many nests are destroyed by humans and human activities, peoples replace nests of sparrow for cleaning their house, in our survey we observe a lady replace 4 sparrow nests from their house on the name of cleaning, we get a replaced nest with 2 dead sparrow babies inside the nest. Many hawks and owls hunt and feed on house sparrows. These include cooper's hawks, marlins, snowy owls, eastern screech owls, and many others. known predators of nesting young or eggs include cats, domestic dogs, raccoons, and many snakes. House sparrows avoid predation by foraging in small flocks so that there are many eyes watching out for potential predators. (Roof, 200

Systemic diseases

Disorders of sodium & osmolality produce CNS neuronal depression, with encephalopathy as the major clinical manifestation; these disorders can also provoke CNS neuronal irritability. Neurologic signs have been reported in a conure after eating salted mixed nuts. (Lightfoot & Yeager, 2008) In house sparrow that ingest small number of road salt granules. (Bollinger *et*

al., 2005)

Conversely, hypocalcemia (McDonald,1988) &Hypomagnesemia (Kirchgessner *et al*.,2012) mainly cause CNS neuronal irritability with seizures. In contrast, disorders of potassium rarely produced clinical signs in the CNS it may be associated with muscle weakness as a major clinical manifestation. Hypoglycemia is another metabolic cause of seizures, especially in younger weanling birds, but also in birds with food deprivation & endocrine & liver disease. Hepatic encephalopathy has been reported in birds with compromised hepatic function like hepatic lipidosis, hemochromatosis (Spalding *et al*.,1986), hepatic neoplasia, & other hepatopathies (Bennet, 1994), while there are no reporters documenting it with hepatic shunts. Nitrogenous waste products, including ammonia, accumulate in the blood crossing the blood-brain barrier & resulting in toxicity in the CNS. (Montesinos *et al*.,2016)

Foremost reasons of population decline-

A. Loss of habitat- That is a primary factor which effect the sparrow the most. Now-a-days sparrow vanished because of their unfavorable habitat condition, mostly sparrow is an adjusting kind of bird, but due to urbanization, changing the pattern of houses windows, no thatch roof, no sun shades so they lost their habitat.

B.Lack of food- Sparrow flocks fly around 1 to 2 miles for searching food such as grains or insects etc. In modern lifestyle peoples tend to buy things in pocket which are pre cleaned. Chance of cleaning and drying grains in front of houses, balconies or in top floors is very less now-a-days. This had led to scarcity of food for these tiny scavenging birds. Other side, In the modern agriculture practices, insects are the second most feed for the young chicks. Usage of broad-spectrum insecticides has let the availability of insect feed to very minimum. It also affects accessibility of poison less fruit.

C. Modern lifestyle- Changing lifestyle have robbed sparrows of their nesting ground. Lifestyle of urban and semi-urban areas have also reflected people's attitude towards bird, animals and biodiversity. New buildings and landscaped gardens which are being constructed are not at all sparrow friendly. Modern glass-clad match box shaped buildings don't have cavities which are important for sparrow to make nests. Use of unleaded petrol may also have a critical impact on the sparrow decline. At the time of combustion of unleaded petrol products methyl nitrate which is highly toxic to small insects which foams major part of sparrow diet.

D.Loss of tree canopy- In the industrial era of development we construct bazaars, mega buildings and even city government tent to extend the width of the road sides for which the urban trees are cut down without understanding ecological importance of the trees or simply ignoring reality fact. sparrow mostly roosts on trees.

E. Ceiling Fans- Most of sparrow injured when they are getting a contact with ceiling fans. Many sparrows lose their life by this and many lose their flying ability.

F.Cell phone towers- Sparrow is not able to stand with the microwave impact from cell phone towers. Due to that the immune system and reproductive abilities are being badly affected, which has resulted in a situation where the erstwhile ubiquitous sparrow is now rarely seen in urban areas. The magnetic waves are affecting the eggs of the sparrows.

G.Pesticides: Another aspect needs to be highlighted here is the pesticide contamination of the environment leading to the decline in the population of the house sparrow especially by

organochlorine pesticides (OCPs). Here an example of bald eagle from USA needs to be considered.A North American species with a historic range from Alaska and Canada to northern Mexico, the bald eagle is an Endangered Species Act success story. Forty years ago, USA national symbol was in danger of extinction throughout most of its range. Habitat destruction and degradation, illegal shooting, and the contamination of its food source, largely as a consequence of DDT, decimated the eagle population.The federal government's banning of DDT and related pesticides, habitat protection afforded by the Endangered Species Act, and conservation actions taken by the American public have helped bald eagles make a remarkable recovery.Shortly after World War II, DDT was hailed as a new pesticide to control mosquitoes and other insects. However, DDT and its residues washed into nearby waterways, where aquatic plants and fish absorbed it. Bald eagles, in turn, were poisoned with DDT when they ate the contaminated fish. The chemical interfered with the ability of the birds to produce strong eggshells.As a result, their eggs had shells so thin that they often broke during incubation or otherwise failed to hatch. DDT also affected other species such as peregrine falcons and brown pelicans. Some other pesticides related to DDT are suspected to have caused increased mortality, in addition to the harmful effects on reproduction. By 1963, with only 417 nesting pairs of bald eagles known to exist, the species was in danger of extinction. As the dangers of DDT became known, in large part due to the 1962 publication of Rachel Carson's book Silent Spring, the Environmental Protection Agency took the historic and, at the time, controversial step of banning the use of DDT and some related pesticides in the United States. That was in 1972, and it was the first step on the road to recovery for the bald eagle (U.S. Fish & Wildlife Service Migratory Bird Program, February 2021). This shows how dangerous DDT contamination is how disastrous it can be for the avian fauna. More scary studies have indicated that we have largely over looked the darker side of these chemicals as OCPs are reported to be carcinogenic (Mathur et al, 2002 &Ingber et al 2013) mutagenic (Ingber et al 2013&Yaduvanshi et al 2012) teratogenic (Yaduvanshi et al 2012 & ATSDR. Atlanta, GA.1994) immunosuppressive (Repetto. R & Baliga. S.S, 1997 &Corsinia et al, 2003) create endocrine dysfunction such as hypothyroidism or high estrogenic activity (Dewailly et al 2000&Rathore et al, 2002) disturb reproductive processes (Pant et al ,2007 &Tiemann.U. 2008) growth depressants (Colborn et al, 1993&Mercier. M, 1981) induces several psychogenic and neurogenic abnormalities in adult stages (Mactutus& Tilson, 1986 & Van Wendel de Jood et al,2001) and are associated with abortions, premature deliveries, still births and infants with low birth weights (Saxena et al, 1981; Saxena et al, 1980; Tyagi et al 2015; Chen. Q et al 2014& Sharma & Bhatnagar, 1996). OCPs have been in use in India nearly for a half century now. Even after having clear cut evidence suggesting that these chemicals have the ability to eliminate entire species from the planet, the annual consumption of pesticides in India is about 85,000 tons of which OCPs comprise the bulk (India Environment Portal Knowledge for change, 30/10/1998.). Therefore, today OCPs are perhaps the most ubiquitous of the potentially harmful chemicals encountered in the environment and are still widely detected in humans despite the considerable decline in environmental concentrations (Dewan et al. 2003). This kind of environmental Contamination with organochlorine pesticides (OCPs) has also been reported by Sharma and her coworkers in 1996 from Jaipur City. She reported contamination of human samples like mothers' blood, cord blood, placenta and mothers' milk with OCPs. Presence of pesticides with OCPs shows that how these xenobiotics have contaminated our Mother Nature and now faunal diversity is facing danger of existence and house sparrow is not staying away from this potential danger. It can be concluded that the magnitude of pollution is quantitatively enough to contaminate the food and environment and reaching out to all faunal diversity. It can be concluded that the

magnitude of pollution is quantitatively enough to contaminate the food and environment and the pesticides reach the human body through various sources mainly by absorption form the gastrointestinal tract through contaminated food chain, are circulated in blood, stored milk and secreted during lactation resulting in sufficient neonatal intake. The battle against the harmful insects would be much less costly and more efficient, and the problem of contamination of the environment by toxic materials would be vastly reduced, if insect activities are controlled by natural means. The use of pest-specific predators; parasites or pathogens; sterilization of insects with the help of radiations; trapping insects using insect attractants like pheromones; use of juvenile hormones or hormone inhibitors may therefore be suggested as alternate ways of pest control (Sharma, 1996; Sharma, M. & Bhatnagar, P, 2017).

Recommendations to save sparrow-

- ✓ Spill over the rejected grains from your household rather than dump them in the dust bins. this activity provides them a little chance to food availability.
- ✓ Install small sparrow boxes in and around the windows, stair cases, balconies and wherever chance of sparrow visit possible. The box should be any kind, that should not wet when raining, should have one-hole access, not reachable by monkey, cat, dog or long durable too.
- ✓ Place a small cap or bowl of water just near bird nesting area have water bath or drink. at the summer time arrives this may help the bird to avoid dehydration and get ride thirsty.
- ✓ Wisely use of pesticides and insecticides. In the agricultural field the insecticide application must be minimized. If required instead of inorganic poison, harmful insecticide, application of poison less eco-friendly organic insecticides such as Panchakavya, dasakaviya should be recommended. over use of these substances are harmful in many ways.
- ✓ Use high quality of fuel in your vehicle is also a critical point to save the e sparrow.
- ✓ Whenever you see sparrow nest, inside your home or around your premise, please do not disturb for simple reason. Try to help them to get some food nearby by throwing grains.

Importance of house sparrow

Every organism in this planet has its own role to play and participate. As a sixth sensed, civilized animals we never thought of other co exiting members of the family. simply concentration on the species improvements and facilitation more luxury which are all paving path to no way back town. Here look at the importance of the most affected common species of the ecosystem.

Maintaining the ecological balance- Sparrow is a very important member of various urban and natural food chains and food web. it feeds on grains like rice, wheat, cumbu etc. and also on larva of mosquitoes, dragon fly etc. There are numerous examples are there to highlight. In 1980, to control the green Inch worms which destroyed thousands of trees in New York city park, house sparrow was introduced to Brooklyn institute, united states. The problem was under control and Noe it is a common bird in U.S.

Insect controller- House sparrow eat the insects which found on agriculture farms. sparrow save the crops by eating insect who destroy the crop. In this way sparrow is also friend of farmer.

Malaria controller- It also feed on larva of mosquitoes which breeds in the water stagnated in

the accessible area of house. The sparrows go in search of larva and feeds on them. This mechanism is a natural pest control process in which human being also favored without any expenses.

Brings prosperity-Sparrows bring prosperity for us, we like to watch this small & lovable bird. Our Childrens always want to observe this cute little bird and always sing songs related with this bird to entertain themselves.

Plant pollination- Pollination is the process of pollen transfer to the female flower as a part of sexual reproduction. sparrows visit many flowers in a day food. At the time of visit they carry pollens and dropped in the female flower that leads to fertilization of the flower, in such a sparrow is very important for pollination.

Cleaning worker- Sparrow Feeds on our dumped kitchen waste, and cleaning the dumping place. By this process diseases occurs from flies being less.

House sparrows are so supportive to study about general biological problems, as pest control. (Roof, 2001)

Education and awareness

World sparrow day is celebrated on march 20 worldwide. The aim and theme behind celebrating world sparrow day to commemorate or show of only for one day, but for using it to highlight the importance of conservation of house sparrow also in urban biodiversity. It provides a platform for conservation or importance of awareness about so serious topic. This event helps to target to bring together like-minded individuals, national & international level group. The aim is also to attention the government agencies & the scientific groups to take notice of the need for the conservation of the very common bird species & urban biodiversity. For instance, in the October, 2012, Delhi Government has announced House sparrow as state bird. It is one of the mile stone in the conservation of the bird & also to emphasis on magnitude of action required to conserve the smaller bird. You can also get involved yourself by just visiting a website: http://www.citizensparrow.in/. In which you can contributed by entering your data of recent house sparrow sitting. Meanwhile you can also get field level information on sparrow status in the same web page as it is funded by Bombay Natural History Society (BNHS) & Ministry of environment & forest etc (Anandan *et al*., 2014).

Acknowledgment:
Our gratitude to Prof. V.K. Singh Vice chancellor and to Head, Department of Environmental Science, Maharaja Ganga Singh University, Bikaner, Rajasthan for providing facilities in the department and their support.

Reference:

1. (Wikipedia)
2. (www.allaboutbird.org)
3. (www.allaboutbird.org/guide/housesparrow/id)
4. (www.cabi.org)
5. (www.termix.com)

6. Agency for Toxic Substances and Diseases Registry (ATSDR)/US Public Health Service, Toxicological Profile for 4,4'-DDT, 4,4'-DDE, 4, 4'-DDD (Update). ATSDR. Atlanta, GA.1994.
7. Bhat, I. A.; Chauhan, P., 2020, "Food Habits of the House Sparrow Passer domesticusindicus in an Arid Environment" Jap. J. Ornithol. 35: 125-128, 1987
8. Bhattacharya, R.; Roy, R.; Goswami, C., 2011, "Studies on the response of House Sparrows to artificial nest", INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCESVolume 1, No 7, 2011.
9. Chamberlain, D.; Evans, M. R.; Shaw, L.M., 2008, "The House Sparrow Passer domesticus in urban areas: Reviewing a possible link between post-decline distribution and human socioeconomic status", Journal of Ornithology 149(3):293-299 · July 2008.
10. Chamberlain, D.; Toms, M. P.; Cleary-McHarg, R.; Banks, A., 2002, "House sparrow (Passer domesticus) habitat use in urbanized landscapes", Journal of Ornithology 148(4):453-462 · September 2007.
11. Chauhan, P.; Irfan, I., 2018," A Review of House Sparrow Population Decline in Kupwara District from Jammu and Kashmir, India", Asian Journal of Agriculture & Life Sciences Vol. 3(2), April 2018:1-3.
12. Chen.Q., Zheng.T., Bassig.B., Cheng.Y., Leaderer.B., Lin.S., Holford.T., Qiu.J., Zhang.Y., Shi.K., Zhu.Y., Niu.J., Li.Y., Guo.Y.H., Huand.X and Jin.Y.(2014): Prenatal Exposure to Polycyclic Aromatic Hydrocarbons and Birth Weight in China," Open Journal of Air Pollution, vol.3, pp. 100-110.
13. Colborn.T., Vom Saal. F.S., Soto A.M (1993): Developmental Effects of Endocrine-Disrupting Chemicals in Wildlife and Human," Environ. Health. Perspect, vol. 101, no. 5, pp.378-384, October.
14. Corsinia.E., Sokootib.M., Gallia.C.L., Morettoc.A and Colosiob.C. (2013): Pesticide induced immunotoxicity in humans: A comprehensive review of the existing evidence,Toxicology. vol. 307, pp. 123–135, May.
15. Dandapat, A.; Banerjee, D.; chakraborty, D., 2010, "The case of the Disappearing House Sparrow (Passer domesticus indicus)", Veterinary World 3(2) · April 2010.
16. Dewailly.E., Ayotte.P., Bruneau.S., Gingras.S., Belles-Isles. M and Roy.R.(2000): Susceptibility to infections and immune status in Inuit infants exposed to organochlorines, Environ Health Perspect., vol.108, no.3, 205–211, March.
17. Dewan, P., Jain, V., Gupta, P., & Banerjee, B. D. (2013). Organochlorine pesticide residues in maternal blood, cord blood, placenta, and breastmilk and their relation to birth size. Chemosphere, 90(5), 1704-1710.
18. https://www.dept.psu.edu/nkbiology/naturetrail/speciespages/house_sparrow.html
19. India Environment Portal Knowledge for change, 30/10/1998.

20. Ingber,S.Z., Buser,M.C., Pohl,H.R., Abadin,H.G.,Murray, H.E.,Scinicariello.F.(2013): DDT/DDE and breast cancer: a meta-analysis. RegulToxicolPharmacol., vol. 67, no. 3, pp. 421-33.
21. Mactutus, C.F and Tilson, H.A (1986): Psychogenic and neurogenic abnormalities after perinatal insecticide exposure. In: Hand book of behavioral teratology. Ed. by Edward, P.R. and Charles, V.V. Plenum Press, NY, 335-91.
22. Mathur, V., Bhatnagar, P., Sharma, R. G., Acharya, V., &Sexana, R. (2002): Breast cancer incidence and exposure to pesticides among women originating from Jaipur. Environment international, 28(5), 331-336.
23. Mercier. M (1981): Criteria (Dose Effect Relationships) for Organochlorine Pesticides Report, Published for the Committee of the European Communities by Pergamon Press.
24. Pant.N., Kumar.R., Mathur.N., Srivastava.S.P.,Saxena. D.K and Gujrati.V.R.(2007): Chlorinated pesticide concentration in semen of fertile and infertile men and correlation with sperm quality" Environ Toxicol and Pharmacol., vol. 23, no. 2, pp. 135–139, March.
25. Peach, W.J.; Idris, M., 2008, "Reproductive success of house sparrows along an urban gradient", Animal Conservation. Print ISSN 1367-9430
26. Rajashekara, S.;Venkatesha, M.G., 2008," Occurrence of house sparrow, Passer domesticus indicus in and around Bangalore", Current science 94(4):446-449 · February 2008.
27. Rathore. M., Bhatnagar. P., Mathur. D and Saxena. G.N. (2002): Burden of organochlorine pesticides in blood and its effect on thyroid hormones in women," Sci Total Environ., vol. 295, no. 1–3, pp. 207–215, August.
28. Repetto.R and Baliga.S.S.(1997): Pesticides and Immunosuppression: The Risks to Public Health," Health Policy Plan., vol. 12, no. 2, pp.97-106.
29. Roof, J.2001. "Passer domesticus"(on-line), Animal Diversity Web. Accessed July 17, 2020 at https://animaldiversity.org/accounts/Passer_domesticus/
30. Saxena, M.C., Siddiqui, M.K.J., Bhargava, A.K., Seth, T.D., Krishnamurti, C.R and Kutty, D. (1980): Role of chlorinated hydrocarbon pesticides in abortions and premature labour. Toxicology. 17. 323-31
31. Saxena, M.C., Siddiqui, M.K.J., Seth, T.D and Krishnamurti, C.R. (1981): Organochlorine pesticides in specimens from women undergoing abortion, premature and full-term delivery. J. of Anal. Toxicol.5, Jan/ Feb.
32. Sharma, M. & Bhatnagar, P. (2017). Pesticide burden in women from Jaipur in relation to ethnicity, religion and addiction habit. International Journal of Environmental Science and Development, Vol. 8, No. 3, 216-220.
33. Sharma, M., & Bhatnagar, P. (1996). Organochlorine pesticides and preterm labour in human beings. Current Science, Vol. 71, No. 8, pp. 628-631.

34. Sharma. M. (1996). Transplacental movement of pesticides in women from Jaipur. Ph.D. thesis submitted to department of Zoology, University of Rajasthan, Jaipur, Rajasthan, India.
35. Shochat, E.; Lerman S.; Fernández-Juricic E., 2010, "Birds in Urban Ecosystems: Population, Dynamics, Community Structure, Biodiversity, and Conservation"
36. Summers-smith, J. D., 2003, "The decline of the House Sparrow: A review" British Birds 96(9):439-446 · September 2003.
37. Tiemann.U. (2008): In vivo and in vitro effects of the organochlorine pesticides DDT, TCPM, methoxychlor, and lindane on the female reproductive tract of mammals: A review, Reproductive Toxicology., vol.25, no. 3, pp. 316–326, April.
38. Tyagi.V., Garg.N., Mustafa. M.D., Banerjee, B.D and Guleria. K. (2015): Organochlorine pesticide levels in maternal blood and placental tissue with reference to preterm birth: A recent trend in North Indian population, Environ Monit Assess., vol.187, no. 7, pp. 471, July.
39. U.S. Fish & Wildlife Service Migratory Bird Program 5275 Leesburg Pike, MS: MB Falls Church, VA 22041 703/358-1714 www.fws.gov/birds/ February 2021
40. VACLAV, R.; HOI, H. 2001, "Importance of colony size and breeding synchrony on behaviour, reproductive success and paternity in house sparrows Passer domesticus" Folia Zool. – 51(1): 35–48 (2002)
41. Van Wendel de Joode.B., Wesseling.C., Kromhout.H., Monge. P., García. M and Mergler. D. (2001): Chronic nervous-system effects of long-term occupational exposure to DDT, Lancet, vol. 357, no. 9261, pp. 1014–1016, March.
42. Whale, H.; Ginn, F., 2012, "IN THE ABSENCE OF SPARROWS" University of Edinburgh, Forthcoming in Landman K and Consulo A eds Environment as/and Mourning McGill-Queen's, University Press
43. Yaduvanshi. S.K, Srivastava.N, F. Marotta.F, S. Jain.S and H. Yadav.H.(2012): Evaluation of micronuclei induction capacity and mutagenicity of organochlorine and organophosphate pesticides, Drug Metab Lett., vol. 6, no. 3, pp. 187-97.