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RESEARCH ARTICLE

NEST STRUCTURE AND NESTING ECOLOGY OF FERAL PIGEON (*Columba livia*) IN NANDED, MAHARASHTRA STATE.

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Abstract

Feral pigeon *Columba livia* is one of the common bird species inhabiting in manmade structures though it may go for feeding away from nesting places. Cement concrete made buildings in use for Govt. departmental offices, educational Institutions, wear houses, sports complex, students hostels are mainly used by this species for nesting. In the current study it has been found adapted for use of readily available plant material to construct the nest. From observed three different types of total 133 nests 95 % were active and reused, 5 % were abandoned nests. Clutch size was 2 eggs per nest with overlapped breeding in 68.5 % nests. Safety of the nest and developing young, rich source of nesting material at selected nesting sites were the most preferred factors identified as main cause of expanding population of this pigeon. No predation of the eggs or young ones was recorded. Nuisance of faecal debris of this pigeon everyday in the main entrance corridor and office building verandas was most notable.

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Introduction:-

Shelter is the most essential need of animals. For self protection and safety of dependent progeny the young ones, various animals use the readily available shelters, modify it or construct the specially designed nests. Birds such as Robin, Bulbul, and House sparrow build and refurbish their nest even after hatching of their eggs and when the young ones open their eyes they are demonstrated by the parents how the nest is built and kept in good condition, this is one type of animal behaviour of parental care. Probably this early age imprinting become long lasting till the young one become adults. But most of the information about building nest is imprinted in the genes of the avian species itself.

Many species in various families of birds re-use their nests; almost all raptors including eagles, hawks, falcons, vultures, etc. have the same nest site and usually the same nest structure year after year. It needs a lot time and efforts to build the nest, there are many bird species like cormorants, herons, storks, weaver birds, egrets that prefers to build communal nesting colonies. They often reuse the same nest sites and a part of their old nest but always add more nest material and repair the damaged region or upgrade to a higher quality nests. Basically any nest takes too much time and efforts to rebuild it but in many birds such as Indian blue rock Pigeon, red vented Bulbul etc. the old nest is often repaired and reused unless there's some serious reason such as attacks by predators, human disturbance or destruction of nesting site. Present study deals with the reuse and reconstruction of old nests by common bird that prefer to live near human habitation the Blue rock pigeon (*Columba livia*) to determine nest structure, nest material

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and selection site for the nesting. The feral pigeon mainly prefer to build nest in city centres for breeding (Sacchi et al. 2002). Some ground nesting birds like Yellow wattled lapwings every year construct new nest due to their annual breeding patterns the old nests destroyed by various factors and they try to select new area every year (Shivaji et al., 2016). There are effects of urbanization on nesting behaviour of this species (Anil Tripathi, 2016).

The Domestic pigeon (*Columba livia domestica*) live and raise their young ones only in residential areas in the readymade carton or wooden boxes which are specially designed and constructed by their owners to fix on the terrace, windows or trees. The domestic pigeons are raised for the commercial, food and hobby purpose. Unlike Domestic pigeon the feral pigeon (*Columba livia*) construct and build their own nest to raise their young ones. The nest of rock pigeon can be seen under the roof of buildings, lintel, on window shields, rock crevices, in or above readymade boxes such as fuse box, electric pump starter box, air conditioner box (A/C), metal boxes etc. The rock pigeon nest seems simple and basic structure rather than having complex structure generally seen in many birds such as Baya weaver (*Ploceus philippinus*) (Achegave et al., 2016). The material of feral Rock Pigeon nest consist of long straight grass sticks, Dried leaf sticks of Neem tree (*Azadiracta indica*), dried leaf sticks of Shankasur plant (*Caesalpinia pulcherrima*) and central rachis sticks of tree leaves that are roughly straight or slightly curved and unbranched. The nest shape is generally constructed by fixing these sticks one up on others. The shape of nest is not seen uniform as it depends up on the place, location and availability of space. Many nests were found constructed by placing only few sticks on slope to avoid rolling of eggs from selected site. Generally these types of nests were seen in the dug wells and rock crevices where usually a depression is present. Some unusual nesting materials mainly pieces of various plastic goods from garbage wastes are also found in the Pigeon nest as an unusual materials (Soniya V. P., 2002).

The feral rock pigeon also known as Indian blue rock pigeon it is a member of family Columbidae. It is commonly known as “Parva” in Marathi language of Maharashtra State. It is approximately 18-20 inches in size (including tail length). Generally the body weight of this pigeon ranges from 250-350 gm. The wingspan is 20-26 inches in range. Sexes look nearly identical, although males are slightly larger than female and have more iridescence on their neck plumage. The body colour variable, but wild birds are gray in colour. This bird is one of the most abundant species of Indian subcontinent and it comes under Least Concerned (LC) species category of IUCN due to the large population found all over India. Sometimes it is also categorized under title of pests (Murton et al., 1972). Pigeons are often found in pairs during breeding season. Wild, domestic and feral pigeons typically mate for life time. Although their long-term bonds are unbreakable and socially monogamous, but extra-pair mating do occur, often initiated by males. Reproduction is oviparous. The female pigeons reach sexual maturity as early as 7 months of age; there is pair selection (Burley N, 1997). In 8 to 12 days after mating, the female lays 1 to 3 (usually 2) white eggs (Fig. 10, 20) which hatch after 18 days incubation (Murton et al. 1972). Both the male and female incubate the eggs but female incubates during the night. The young ones leave the nest in 25 to 29 days after hatching. Initially the young are fed “Crop milk” (regurgitated thick liquid food from the parent’s crops). More eggs are laid before the first clutch leaves the nest. The average clutch time is around 2 month approximately if the food availability is abundant. Breeding may occur in all seasons. Pigeon species show different plumage patterns within the same species (Hetmanski and Jarosiewicz (2008). The feral pigeons never built the nests close to ground or on the objects on the ground or as open ground nests of Yellow wattled lapwing (Tomasz and Elzbieta, 2005), Black winged Stilts, Golden ringed plovers, Red Wattled Lapwing.

Materials and Methods:-

For this investigation study area- S. R. T. M. University, campus at Nanded was selected. Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra State is having 650 acre area with thick vegetation found in different regions surrounded by open wood lands dominated by Babool (*Acacia nilotica*), Ber (*Zizipus mauritiana*), Sagvan (*Tectona grandis*), Neem (*Azadiracta indica*), Shankasur (*Caesalpinia pulcherrima*) and number of shrubs are also found in the University campus area. Already there are reports on the occurrence of this pigeon species in the University area and its nuisance value (Chavan et al. 2015). The University campus include more than 25 buildings out of which 17 buildings were selected for this study due to presence of feral pigeon nesting at these sites. The selected area was found good for the feral pigeon nesting and breeding due to available resources and abundance of nesting places (Achegave et al. 2016; Jadhav et al. 2018). The study area includes the cement concrete buildings and infrastructures which are quite old but provides good habitat for the feral pigeon nesting (Kalsi and Kalsi, 1992). The Nikon P510 (42 X zoom 14 MP, point and shoot) camera was used to take photographs from safe distance without disturbing the birds and their nest. Post capture photo processing was done by using Microsoft Picture Manager for the basic editing. The photographs were labelled using Microsoft Paint Software. During this

study only photographs of the birds, bird nests, eggs and chicks were taken. A good quality binocular was also used for tracing the birds from distance. To determine the nesting ecology of the Feral Rock Pigeon in the various habitats of the University campus data was collected by observations through the trekking method, general observations, bird watching methods, and field observations. The data was collected during November 2017 to April 2018. The feral rock pigeon nests were categorized on the basis of their shape as whole nests or roughly rounded, half circular and irregular nests. The species of bird was identified by using standard references (Grimmett et al. 2011). The area selected in the University campus was divided into 4 parts A, B, C and D by using Google map for the convenience. For the calculations on nest specifications and nest density per building line transect method was used. The selected area specifications in this study were mainly the cement concrete buildings.

Area A: School of Pharmacy, School of Commerce and management, School of Computational Sciences, School of Social Sciences, S. R. T. M. University Guest house

Area B: Girl's Hostels, School of Educational Sciences, School of Fine and Performing Art, School of Media and Mass Communication Studies and Central Library.

Area C: School of Languages, Literature and Culture Studies, School of Interdisciplinary Studies, School of Earth Sciences, School of Chemical Sciences.

Area D: School of Physical Sciences, School of Life Sciences, Administrative building, A dug well near S. R. T. M. University main entrance gate near highway.

Results and Discussion:-

The structure and shape of feral pigeon nest was quite simple and basic. The shape of nest was not uniform as it depends up on the place, location (where it built?) and availability of space. The material of these nests consists of straight, long, un-branched, dry leaves sticks of Neem tree (*Azadiracta indica*) and Shankasur flower plant (*Caesalpinia pulcherrima*) and some grass sticks having nearly same structure. Nest constructed by fixing these sticks one upon others. The size and length of the material chosen was not uniform. As we observed the structure of the feral pigeon's nests can be divided into three types such as 1) Whole nest or roughly circular Nest, 2) Half Circular Nest, 3) Irregular Nest.

Whole nest or roughly circular nest:

The size and length of plant material used for building of nest by feral pigeon seems almost uniform hence most of the time nest was of roughly circular or rounded in shape. Therefore the nests are constructed by feral pigeon generally at the places where the space is good enough for the completion of circumference of nest (Above fuse boxes, A/C boxes, under the roof, Window shield, lintel etc.) (Fig.1-20). Circular nest usually ranges from approximately 22 - 25 cm i.e. outer circumference of the nest as shown in (Fig. 2). While inner circumference of the nest cup was 10 - 12 cm. In the nest cup area one individual at once with eggs or chick fits barely. Once the chicks come out of the eggs and start to grow up to large size and unable to fit in the nest, chicks get out of the nest and feeding is given near to the nest. During this stage another set of eggs were found in most of the nests as observed.

Half circular Nest:

The half circular nests were observed at the ready made available places where the safe nest can be constructed such as in the readymade boxes (fuse boxes, iron boxes etc.). This type of nests are covered or guarded by the wall or any other covering from one or two sides (Fig. 3.). Hence the Pigeon pair constructs the nest of half size only. This type of nest seems unstable but it remains at its place for long time because no disturbance as compared to whole nest or circular nest. The size and shape of such nest depends up on the site where it is built.

Irregular nest:

These types of nests are generally seen at the places where pit or depression is already present. The nest constructed only by placing few plant sticks on the slope area to prevent rolling of eggs (Fig. 4.). Such type of nest can be seen at the plain places also. This type of nest indicates the brood pair needs less construction efforts, though this type of nest seems basic but it works well to raise the chicks. During this study total 133 numbers of nests of Feral Rock Pigeon were observed in selected study area Swami Ramanand Teerth Marathwada University Campus, Nanded. In Area 'A' 31, area 'B' 52, area 'C' 25 and in area 'D' 25 nests were found. The percentage occupied by nests according to area A, B, C, D recorded was 23%, 39%, 19% and 19% respectively (Table 2.). Study area 'B' among A, B, C, D represents greatest nest density. The percentage nesting according to site of nesting was 20% in or above readymade boxes, 33% under the roof of building, 13% above the lintel and 33% on window shield. It was found that major habitat preferred by the Feral Rock Pigeon for their nesting site was human habitation and few sites

which can be included in their natural nesting sites. Only 1% nests out of 133 were found in natural nesting habitation such as rock crevices, rock gaps and rock holes etc. 95% nests among 133 were reconstructed and under reuse in successive breeding cycle by the same Pigeon pair and considered as active nests, while very few of the nests were abandoned (5%). There are factors like infection by mites and lice to rock dove that decide the reproductive success that indirectly related to nest building in these birds.

This is the first ever study report in Nanded region on the nesting ecology of Feral Rock Pigeon. The density of nests was depending up on the availability of space and type of shelter where the nests were built. These nests were abundantly found all over the study area especially near the human habitation on cement concrete buildings and infrastructures under the roofs, in or above the readymade boxes such as fuse box, electric starter box, A/C boxes etc. Besides these Feral Rock Pigeon nests are also found in its natural habitation such as the rock crevices, holes and gaps in rocks, inside the wells, rock walls etc. There are several reasons such as destruction of their natural habitat, increasing urbanization^[3] and scarcity of food etc. due to which Feral Rock Pigeon preferring their nesting site in and around human habitation. Hence increasing population of this species is causing increasing troubles for humans as well as for themselves. Feral Rock Pigeon reuse and rebuild their nests year after year this results in deposition of their faecal matter in and around the nest and nesting material due to which humans destroy their nests and nesting sites in order to save beauty of buildings, statues, heritage monuments and other nesting sites. Present study is very important documented data that define and express valuable information about nesting ecology of this species that will be useful for researchers, students, department of forest, Government of Maharashtra and common peoples. The nesting in birds to correlate nest-building behaviour to the origin and early evolution of passerine birds (Order Passeriformes) and supported evidence for the hypothesis that the combination of small body size and the ability to place a constructed nest where the bird chooses, helped make possible a vast amount of adaptive radiation (**Chavan et al. 2016, Collias NS, 1997**). Cavity or hole nests (in ground or tree), open-cup nests (outside of holes), and domed nests (with a constructed roof) were all present very early in evolution of the Passeriformes, as indicated by the presence of all three of these basic nest types among the most primitive families of living passerine birds. Each basic type of nest built by passerines has advantages and disadvantages in specific ecological situations, and nest type depends on a balance of multiple factors that involve the nest site, the physical environment, the community, size and behaviour of the birds. In the present study the space and food availability for feral pigeon found to cause increase in nest density in human habitation area. It is stated in a study (**Hetmanski and Wolk, 2005**) that clutch overlap is a reproductive strategy of the Feral Pigeon, which results in an increase in the number of clutches produced by a pair and increase in the number of young raised. It is dependent on the time length for care of clutch and the interval between two successive clutches. It was also found that nesting conditions like the number of nests in a breeding pair's territory, brood size and location of the nest in the colony. It also influences the duration of clutch care, the length of clutch interval and the degree of clutch overlap. The clutch interval was shorter when parents only cared for one young, than when two young were in the nest. Breeding pairs with large territories that included two nests had shorter clutch intervals than those pairs with only one nest. In the present study the clutch overlap was 1-2 % amongst the observed 133 nests. A census on feral pigeons (**Sacchi et al. 2002**) (*Columba livia*); in Milan, Italy in 181 km² area to examine population densities in different urban habitats and the relationships between population density and structural features of buildings found that the pigeon population was 103 650 birds, with an average density of 570/km². There was a positive relationship between both bird number and flock number and the abundance of buildings constructed before 1936 indicated active selection of old buildings by feral pigeons. Here the selection of concrete buildings for nesting by the pigeon indicates adaptation to existing conditions that favours in other aspects like safety and availability of places for nesting and food resource that was not found in the research by **Socchi et al. (2002)**. In the similar study which was designed to determine the ecology of feral pigeon (*Columba livia*) in the urban areas of Rawalpindi/Islamabad, Pakistan (**Ali et. al., 2016**) the roosting sites, nesting sites, food and water points did differ in different seasons. Highest population of the pigeon was recorded in old buildings (0.30 individual/ha) and lowest in parklands (0.008 individual/ha). In this study also population density of the pigeon mainly concentrated in old buildings; roosting sites, nesting sites, food and water points used by pigeons changed with respect to different seasons. These results also coincide with present observations. The age of nest also influenced the breeding season (**Hetmanski, 2004**). Many other factors were found to cause nesting and incubation related damages that includes eggs and nestling loss, mechanical damage to eggs, eggs and nestlings falling out of the nests, embryo death, competition among fledglings and nestlings disease were dependent on the level of pigeons reproductive activity, especially in overly dense colonies. The well built nests with high stability protect the brood from falling (**Coon et al. 1981**) whereas in the present study important factor observed related to nest damage was routine cleaning of some of the buildings otherwise at 90 % places approximately all nests were safe and breeding was successful. It was first study of its kind to determine the nest structure and nest density in S. R. T. M. University

campus Nanded. We are of the opinion that this data will be useful for further planning and building extensions, to decide the designs of buildings, regular maintenance of the buildings so as to control the pigeon population and keep away these birds to prevent their nuisance value. It is clear that the breeding pairs of feral pigeon use the same nesting sites for many years when confirmed its safety though they have to go for long distance for foraging (Hetmanski and Wolk, 2005).

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Table 1:- Location and Number of nests observed in study area S. R. T. M. University, Nanded.

Sr. No.	Name of Department/ Building /Structure	Locations of Nest				
		In/ above Readymade Box	Under the Roof	Lintel	Window Shield	Total
Area A: total number of nests =31						
1	School Of Pharmacy	02	-	02	03	07
2	School Of Computational sciences	-	-	-	04	04
3	School Of commerce and Management	-	01	01	03	05
4	School Of Social Sciences	-	03	01	06	10
5	S.R.T. University Guest house	01	02	01	01	05
Area B: total number of nests=52						
6	Girl's Hostel S. R. T. M. University Nanded.	16	10	08	06	40
7	School Of Educational Sciences.	-	01	03	02	06
8	School Of Fine and Performing Arts	01	01	-	03	05
9	School Of Media and Mass studies	-	-	-	01	01
10	Central Library	-	-	-	-	0
Area C: : total number of nests=25						
11	School of Language and Literature and culture studies	-	04	-	03	07
12	School of Interdisciplinary	-	-	-	01	01
13	School of Earth Sciences	03	04	-	04	11
14	School of Chemical Sciences	-	06	-	-	06
Area D: total number of nests =25						
15	School of Physical Sciences	01	02	-	01	04
16	School of Life Sciences	-	02	-	02	04
17	Administrative Building	02	08	01	04	15
18	Dug well near S.R.T.M. University (main gate)	Feral Rock Dove nest was also found in the rock crevices(1) and PVC pipe (1) .				

Table 2:-Number of nests and percentage in area A, B, C and D at S.R.T.M. University, Nanded.

Sr. No.	Area	Total number of nests/ Area	Nest Percentage/ Area
1	A	31	23%
2	B	52	39%
3	C	25	19%
4	D	25	19%

Table 3:-Location wise Number and percentage of Pigeon nests at different locations in nests in S.R.T.M. University at Nanded (Study area)

Sr. No.	Location Of Nest	Total Number of Nest	Nest Percentage
1	In/Above the readymade boxes	26	20%
2	Under the Roof	44	33%
3	Above Lintel	17	13%
4	Window Shield	44	33%
5	Inside Well	02	1%



Fig. 1:-Distant view of Blue Rock Pigeon Nest on A/C iron bracket.



Fig. 2:-Zoomed view of Blue Rock Pigeon Nest on A/C iron bracket.



Fig. 3:-Pigeon nest spotted on the same building in Girl's hostel S. R. T. M. University, Nanded



Fig.4:-Reconstruction of same existing nest after a few days.



Fig.5:-Nest constructed under roof of Building in girl's hostel.



Fig. 6:-Zoomed View of nest (in Fig. 5).

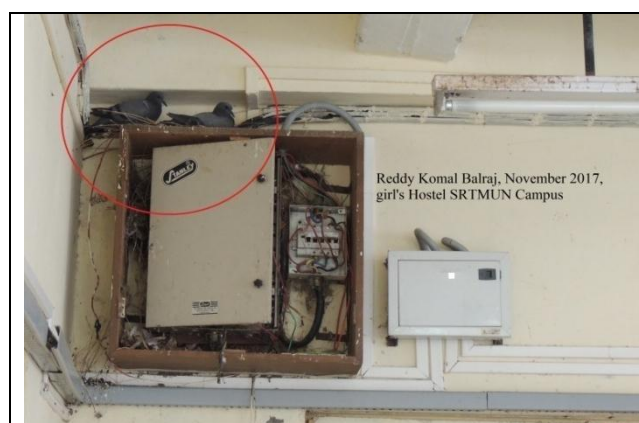


Fig.7:-Nest constructed above fuse box.

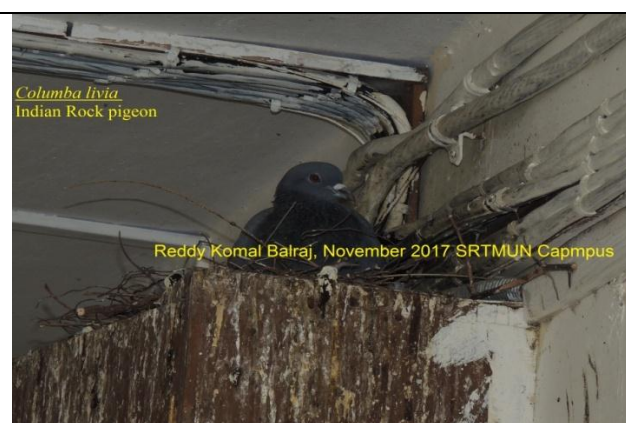


Fig.8:-View of nest constructed above fuse box.

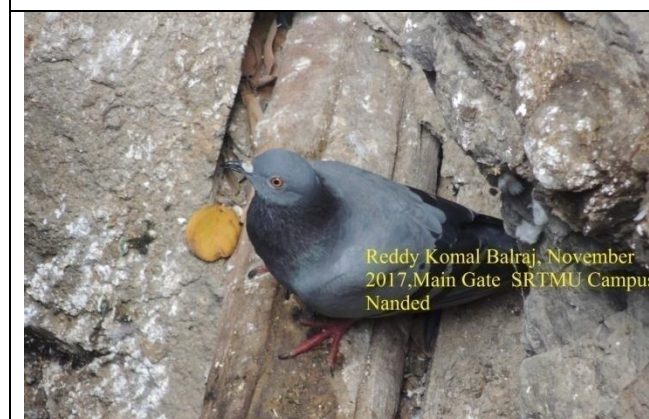


Fig. 9:-Nest constructed in rock crevices of Dug well S. R M. U. Nanded



Fig.10:-Nest with eggs in rock crevices of dug well near main gate of S. R. T. M. U. Nanded



Fig.11:-Nest constructed inside fuse box in Girl's Hostel S.R.T.M.U. Nanded



Fig.12:-Nest with eggs above fuse box in girl's hostel S.R.T.M.U. Nanded



Fig.13:-Zoomed view of Nest School of life sciences, S.R.T.M.U. Nanded

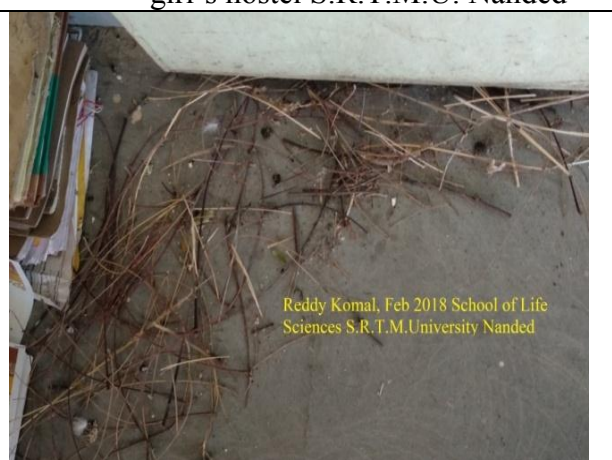


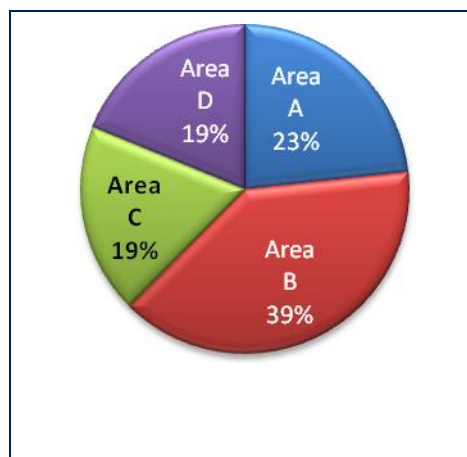
Fig.14. Destroyed nest during cleaning of building premise.



Fig.15:-Pair returned to reintroduced nest and start living.



Fig.16:-Nest Constructed above fuse box at



School of Physical Sciences S.R.T.M.U.N



Fig.17:-Reconstructed and reused nest having Layers.

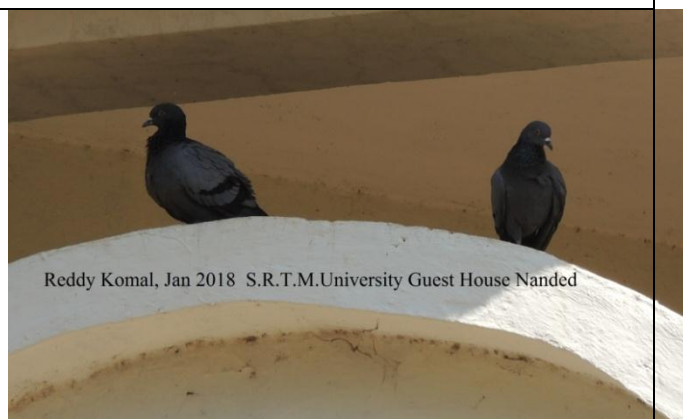


Fig.18:-Nest located under the roof on Guest house S. R. T. M. U. Nanded



Fig.19:-Nest located on window shield at School of Social Sciences, S. R. T. M. U. Nanded



Fig. 20:-Whole nest with eggs at School of Fine & Performing Arts, S. R. T. M. U. Nanded.

Fig. 21:-Nest percentage of Feral Rock Pigeon in study area A, B,C,D at S.R.T.M.University Nanded.

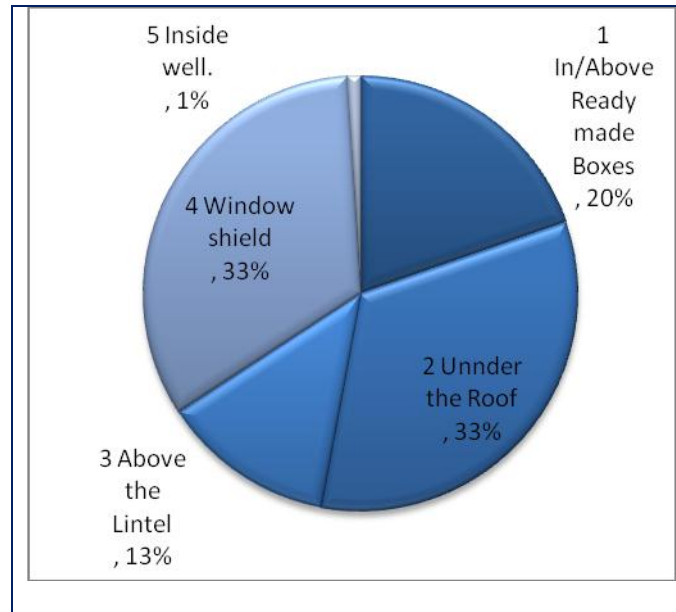


Fig. 22:-Location wise number and percentage of Pigeon nests in S.R.T.M.U.N campus, Nanded.

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