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Breeding biology of barn swallow (*Hirundo rustica*) at Tehsil Balakot, Pakistan

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Abstract

This study was conducted at Tehsil Balakot in District Mansehra, during the breeding season February to June 2014. Details about nests and eggs characteristics are provided. All nests were attached to vertical walls and roofs of buildings and situated at mean height 2.8 ± 0.43 m above ground with nest diameter 14.78 ± 3.13 cm, nest depth 3.97 ± 0.90 cm, nest cup diameter 10.91 ± 2.46 cm and nest cup depth 3.27 ± 0.80 cm. Nests attached to cemented walls were (46.3%), plastic surfaces (20.4%), wooden materials (16.7%), soil walls (11.1%) and to mirrors (5.6%). The average clutch size was 3.7 ranged 2 - 5. Mean egg length was 18.50 ± 1.6 mm, breadth 13.6 ± 1.2 mm, egg volume 1.80 ± 0.5 cm³, egg shape index 1.36 ± 0.03 and egg weight was recorded 1.81 ± 0.1 g. Egg and nest success was 76% and 85%. Hatchling and fledgling produced per nest was 2.84 and 2.44. Main causes for reproductive failures were unhatched and broken eggs, predation and observer's disruption.

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Introduction

Family Hirundinidae includes 84 species of Passerines widely distributed in Tropical and Temperate regions, and among Hirundinidae Barn Swallow (*Hirundo rustica*) is the most widespread species of swallows in the world (Turner and Rose, 1989; Turner, 2004). But local declines in populations of the many areas have been reported (Tucker and Heath, 1994; Robinson *et al.* 2003). Still very little is known about the population trends and breeding biology of Barn Swallows in Pakistan. Although in Pakistan, Barn Swallow is a well-known summer breeding bird in the western hill tracts and in northern mountainous areas (Roberts, 1992). It is a small bird with steel-blue colored upper parts, white under parts and a rufous-chestnut forehead, chin and throat (Higgins *et al.* 2006). A well-defined blue breast-band and long outer tail feathers help distinguish the species. Sexes are similar but females lack the length in tail streamers (tail feathers are forked in both sexes) and the white markings on outer tail feathers are also shorter (Higgins *et al.* 2006). These birds are highly aerial and exclusively insectivores (Turner, 2004). The Barn Swallow is a common bird known from Andamans, Myanmar, Malay Peninsula and Indonesia (Ali and Ripley, 1987; Turner, 2004).

Available information on the reproductive traits of hirundines that breed in the tropics shows significant deviation from the typical traits of tropical birds (Hails, 1984; Ali and Ripley, 1987; Turner 2004). Many of them have large clutch size and longer developmental periods compared to that of temperate birds (Ali and Ripley, 1987; Turner, 2004). Many investigations have been carried out to know the breeding aspects of Barn Swallows during past two decades including (Robert, 1992; Moller, 1994; Jaunet *al.* 1998; Dolenec, 2002; Sakraoui *et al.* 2005; Pawel and Piotr, 2008; Balakrishnan, 2010; Patrick and John, 2010; Dolenec, 2013) but no scientific work is done in Pakistan so far, so it is a first kind of published paper related to Breeding Biology of Barn Swallow in Pakistan. The aim of this paper is to present; (1)

Breeding timing and nest characteristics including nest height, architecture, attachments and dimensions. (2) Clutch size and egg characteristics including egg dimensions (length, breadth, volume/size and egg shape index). (3) Breeding success and failures of Barn Swallows.

Timing of egg laying, hatchlings and fledglings, hatchling and fledgling weight and body measurements are some of the aspects which still need to be investigated in the study area.

Material and methods

Study area

This study was conducted at Tehsil Balakot 34°33'N and 73°21'E in Mansehra District that is famous tourist destination of the region and the gateway to Kaghan Valley. It is located at about thirty-eight kilometers east of Mansehra city. Tehsil Balakot is bordered in west with the Tehsil Mansehra of the District Mansehra while in east it is bordered with the Muzafarabad District of Azad Jammu and Kashmir, in north it is bordered with the Kohistan District and in south it is bordered with the Abbottabad District. Tehsil Balakot is the largest Tehsil of District Mansehra. It has humid subtropical climate with hot summers and cool winters. Rainfall is much higher than in most other parts of Pakistan. Average rain fall hold by Tehsil Balakot is 1744 mm per year.

Sampling

The duration of the study spanned 5 months, February to June 2014. Nests search begun in the early February. All the nests were found during that time. In this way 54 nests of Barn Swallow were found and later 45 nests become active. All the nests were inspected directly to see the anterior of nest and for that purpose 10 feet long ladder was used. Photographs were taken by Traveller XS-4000 digital camera with 4X optical zoom and 5.0-20.0 mm lenses. Statistical analyses were performed by using One Way ANOVA and all the mean values are given with Standard Deviation (Mean $\pm$ SD).

Nest height from ground and nest dimensions (depth and diameter) were measured by common measuring tape. Egg weight was taken on common weighing bar. Egg length and breadth was measured by Vernier Calliper with Least Count 0.1 mm. Egg volume was calculated from the length and breadth using the formula (Hoyt, 1979).

$$V=0.51 \times L \times B^2 / 1000.$$

Where V is volume in cm^3 , L is length and B is breadth in mm. An egg shape index (ESI) was calculated by dividing L/B.

Murray (2000) was followed to calculate egg and nest success as measures of reproductive success. Egg success is “the proportion of eggs that produces young” and nest success is “the proportion of clutches that produces young”. Thus, number of young that leaves the nests divided by total number of eggs gave

egg success while number of clutches that produces young was divided by total number of clutches to obtain nest success.

Results

Breeding timing and nest attachments

Total of 54 Barn Swallow nests were found during the breeding period of February to June 2014. Of these 54 nests, later 45 nests found to be active. First clutch was found in the mid-March and none of the clutch was found after the late May. Barn Swallow usually made nests on artificial structures. In the study area all the nests were found on artificial structures, among 54 nests, most of nests were attached to cemented walls $n=25$ (46.3%), plastic surfaces $n=11$ (20.4%), wooden materials $n=9$ (16.7%), soil walls $n=6$ (11.1%) and mirror $n=3$ (5.6%) see (Table 1).

Table 1. Number and Percentage of Barn Swallows nests attached to different surfaces.

Materials	n	%
Nest attached to woods	9	16.7
Nest attached to plastic contents	11	20.4
Nest attached to cemented walls	25	46.3
Nest attached to mirrors	3	5.6
Nest attached to soil walls	6	11.1
Total	54	100

n = number of nests, $\%$ = percentage of nests.

Nest architecture and nest dimensions

The nest of Barn Swallow is usually cup shaped and is made with mud pellets as major structural constituent. The mud pellets used to build the nest consist of sand and smaller amounts of silt and clay. The nest chamber is lined sparingly with grasses, hair, and feathers. The mean nest height of nest from the ground was measured to be 2.8 ± 0.43 m (Range=2.5-

2.9 m), mean diameter of the nest was 14.7 ± 3.13 cm (Range=14.8-15.3 cm) and mean nest depth was 3.9 ± 0.90 cm (Range=3.7-4.3 cm). While mean nest cup diameter was measured 10.91 ± 2.46 m (Range=10.5-11.4 m) and nest cup depth was measured to be 3.3 ± 0.80 (Range=3.2-3.6 cm) given in (Table 2).

Table 2. Dimensions of Barn Swallow nests.

Nest Dimensions	Values	Range R	Nest cup dimensions	Values	Range R
Height (m)	2.8 ± 0.43	2.5-2.9	-	-	-
Diameter (cm)	14.7 ± 3.13	14.8-15.3	Diameter (cm)	10.9 ± 2.46	10.5-11.4
Depth (cm)	3.9 ± 0.90	3.7-4.3	Depth (cm)	3.3 ± 0.80	3.2-3.6

Clutch size and egg traits

Clutch size refers to number of eggs laid in a nest. Clutch size of Barn swallow was 3.7 with egg ranges from 2-5 and most of clutches contained 4 eggs. The eggs were cream to pinkish white color, with spots that can be brown, lavender or gray (Fig.1). Total of

167 eggs were recorded from 45 active nests, clutches with 2 eggs were found to be 6 (7.19%), clutches with 3 eggs were found to be 11 (19.76%), clutches with 4 eggs were found to be 18 (43.1%) and clutches with 5 eggs were found to be 10 (29.9%) given in (Table 3).

Table 3. Clutch size range, total number of clutches and eggs of Barn Swallow.

S. No	Clutch Size Range (R)	Clutches (N)	Eggs (n)	Percentage %
1	2	6	12	7.19
2	3	11	33	19.76
3	4	18	72	43.1
4	5	10	50	29.9
Total	2-5	45	167	100

Mean egg length of Barn Swallow egg was measured 18.50 ± 1.6 mm (Range=16.0–21.0 mm), mean egg breadth 13.6 ± 1.2 mm (Range=12.0–16.0 mm), mean egg volume 1.80 ± 0.5 cm³ (Range= 1.18–2.74 cm³),

mean egg shape index 1.36 ± 0.0 (Range=1.31–1.38) and mean egg weight was recorded to be 1.81 ± 0.1 g (Range=1.6–2.0 g) given in (Table 4).

Table 4. Egg traits of Barn Swallow.

Egg traits	Mean $\pm$ SD	R	N
Egg width (mm)	13.63 ± 1.2	12.0–16.0	167
Egg length (mm)	18.5 ± 1.6	16.0–21.0	167
Egg volume (cm ³)	1.80 ± 0.5	1.18–2.74	167
Egg shape Index	1.36 ± 0.03	1.31–1.38	167
Egg weight (g)	1.81 ± 0.1	1.6–2.0	167

SD= Standard Deviation, R= Range, N= No of eggs.

Statistical analysis between the egg dimensions of the barn Swallow shows that egg length and width has no significant difference ($P > 0.05$), similarly egg weight and egg shape index also has no significant difference ($P > 0.05$) while egg shape index and volume has significant difference ($P < 0.05$).

*Breeding success**Egg success and nest success*

Total of 167 eggs were recorded from the 45 clutches. Of these 167 eggs 128 chicks hatched from eggs, so egg success was 76.0 % (128/167). Of these 128 newborns from 45 nests, only 110 produce successful fledglings so nest success was 85.0 % (110/128). Number of hatchling produced per nest was 2.84 (128/45) and number of fledglings produced per nest was 2.44 (110/45) given in (Table 5).

Table 5. Reproductive achievements of Barn Swallow.

List	Reproductive Achievement
No. of nests	54
No. of active nests	45
Total no. of eggs	167
No. of hatchlings	128
No. of fledglings	110
Clutch size	3.71
Egg success	76.6
Nest success	85.9
Fledglings/nest	2.44

*Breeding failures**Egg failures*

Of 167 eggs found in 45 clutches only 128 eggs hatched. Eggs remained unsuccessful were 39 due to these reasons; eggs remained unhatched were n=25

(15 %), eggs destroyed by House sparrow n=5 (3.0 %), eggs destroyed accidentally during inspection n=3 (1.8 %), broken eggs found in the nests n=6 (3.6 %). A total egg failure in the study area was 23.4% (Table 6).

Table 6. Causes of Barn Swallow eggs and hatchlings failures.

Causes of Failures	Egg Failures	Percentage	Hatchling Failures	Percentage
	n	%	N	%
Unhatched eggs	25	15.0	-	-
Predated by House Sparrow	5	3.0	7	5.5
Eggs destroyed during inspection	3	1.8	-	-
Broken eggs found from nests	6	3.6	-	-
Bad location of nests	-	-	3	2.3
Mortality (Unknown causes)	-	-	8	6.3
Total Failures	39	23.4%	18	14.1%

Hatchling failures

Of 128 nestlings only 110 will become able to fledge and 18 failed to produce fledglings due to these reasons: Chicks found dead due to predation of House sparrow was n=7 (5.5 %), chicks fallen from nest n=3 (2.3%) and chicks found dead due to unknown causes n=8 (6.3 %). Total hatchlings failure in the study area 14.1% (Table 6).

Ghats, India. In Srilanka few nests were also recorded (November to December) and indicated breeding season starts from December to June (Ali and Ripley, 1987). Substantial regional variation in time of breeding is seen by different authors so additional studies are required to know factors like plenty of insects, rainfall, temperature etc.

Discussion

Hirundines display substantial geographical differences in the timing of breeding. Swallow breeding time is March to June in Baghdad (Al-Raway and George, 1966). In North Africa and South Spain, Swallow starts laying in March reported by Turner (1994). Nesting is limited to wet season in tropics and subtropics when insects are in plenty and some time it occurs during rainy season (Turner, 2004). Majority of birds breed during March-July in India reported by Ali and Ripley (1987). In study area breeding of Barn Swallow is restricted to rainy season (Feb to June) and is contrasted with breeding season (March to May) records of Ali and Ripley (1987) in Southern India. In Algeria, breeding season was between April and May reported by Sakraoui *et al.* (2005) and is similar to our study area. Similarly, Feb to April records of Balakrishnan (2010) in Western

All most all species of Swallows are known to use artificial structures for roosting and nesting (Hails, 1984; Ali and Ripley, 1987; Oatley, 2002; Jackson and Spottiswoode, 2004; Turner, 2004). In the Western Palearctic barn Swallow prefer buildings for their nests where livestock is kept (Moller, 1983; Cramp, 1988; Turner, 1994). Barn Swallow places the nest close to ceiling, beams, and walls at a specific height reported by Pikula and Beklova (1987). All nests of Barn Swallow in this study were attached to artificial structures like walls, roofs, wooden materials and mirrors etc. Swallows nested in different man-made structures in Algeria including factories, garages and balconies in buildings (Sakraoui *et al.* 2005). Barn Swallows attach their nests to diversity of structures including walls or rock-face, under road culverts or in tunnels and most commonly under eaves or against ceiling beams and rafters in houses reported by Ali and Ripley (1987).

Barn Swallow built its nest at a specific height in study area, height of nest from ground was measured to be 2.8 m (Range=2.7-2.9) and contrasted to present study, Moller (1985) found nest height 2.0-5.0 m, similarly McGinn and Clark (1978) found the majority of nests at 3.0-4.5 m above the ground which is slightly greater in value while nests were situated at a height of 1.5-4.5 m above ground

reported by Roberts(1992) and nest dimensions were also greater as contrasted to present investigation found by other authors. Nests were found at height of 2.5 m in North West Croatia (Dolonec, 2002) which is slightly less in value recorded by us. Barn Swallow built their nest at height of 3.9 m in Algeria recorded by Sakraoui *et al.* (2005) which is more recorded by us in study area.

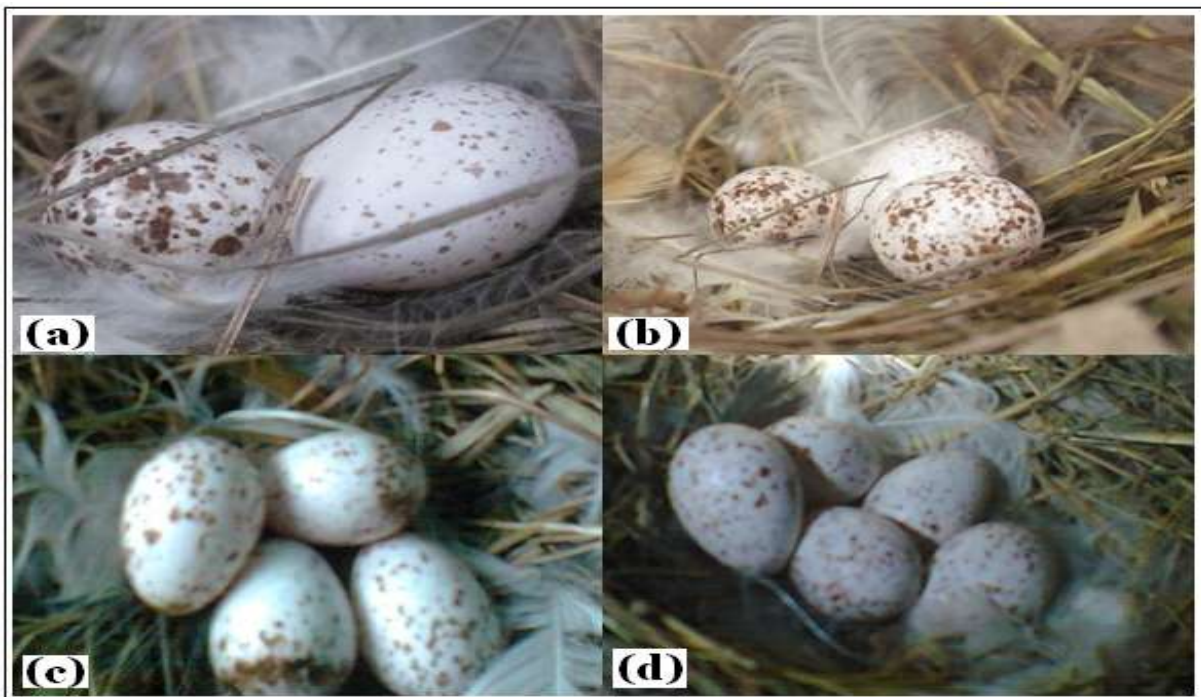


Fig. 1. Different clutches of Barn Swallow; (a) clutch with 2 eggs (b) clutch with 3 eggs (c) clutch size with 4 eggs (d) clutch size with 5 eggs.

Clutch size of Hirundines in the temperate habitats is 3-6 eggs and sometimes up to 8 eggs (Turner, 2004), though the usual clutch size in the tropics is 2-5 eggs (Ali and Ripley, 1987; Turner and Rose, 1989; Turner, 2004). Clutch size recorded by Dolonec (2002) was 4.56 eggs which was greater than recorded by us. Average clutch size of Barn Swallow in the study is 3.71 with egg range 2-5 reported similar to swallow breeding in mainland India (*Hirundo rustica*: 4-6 eggs, *H. smithii*: 3-5 eggs, *H. flavicola*: 3-4 eggs, *H. daurica*: 3-5 eggs, *H. striolata*: 3-5 eggs; (Ali and Ripley, 1987). The mean clutch size of Barn Swallows is significantly smaller to the conspecific House Swallow *Hirundo tahitica* in Malaysia (mean=2.98, range=2-5 eggs (Hails, 1984). The median clutch size

(3.5 eggs) reported for the passerines in India are similar to Barn Swallow (Ali and Ripley, 1987; Pramod and Yom-Tov, 2000). In most of hirundines seasonal failure of clutch size is reported (Hails, 1984; Sakraoui *et al.* 2005; Turner, 2004), however this could be attributed to the late breeding of young inexperienced birds which normally lay lesser clutches (Turner, 2004). Although, such seasonal declines were not identified in nesting of Barn Swallows. The results of egg dimensions including length recorded 18.5 mm and breadth 13.6 mm of this study agree with those of many others, Horak *et al.* (1995) have shown that egg length is more variable than breadth, Cramp *et al.* (1988) gives an egg length of 19.7 mm and egg breadth 13.6 mm and Verheyen

(1967) reported egg length and breadth of 20.2 and 13.7 mm. Egg length and breadth was more recorded by Dolonec (2002) and Sakraoui *et al.* (2005) was also greater in size than recorded by us. In birds, clutch size and egg size vary with laying date (Hails, 1984) female age (Desrochers and McGrath, 1993) year (Perrins, 1969), laying order (Murphy, 1994) food availability (Boekelheide and Ainley, 1989) female condition (Horak *et al.* 1995), heritage (Noordwijk *et al.* 1980) and other factors.

High hatching (90% or more) and fledgling success (38-80%) rates are commonly reported for most species of hirundines (Turner, 2004). The overall nesting success of Barn Swallow 85 % in study area calculated based on the Murray (2000) method was slightly higher to other hirundines. Sakraoui *et al.* (2005) in Annaba breeding success 70.6% which is less than recorded by us. Predation at the nests was reported minimal in majority of the hirundines species studied (Earle, 1989; Jackson and Spottiswoode, 2004; Turner, 2004). As compared to other studies in present investigation predation reported was minimal; 3.3% of eggs and 5.5% of hatchlings were predated by House Crow. Other potential predators reported by other authors in range of species were snakes (Indian Rat Snake *Ptyas mucosa*), owls (unidentified species) and several species of bats (Indian False Vampire Bat *Megadermalyra*) and lizards (*Gekko gecko* or *Gekkostentor*) for *H. tahitica* (Hails, 1984). Further concentrated studies using advanced methods (Video Surveillance Monitoring) are required to identify the nest predators of *H. rustica*.

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