Study of incubation and Hatching Rate of Common moorhen, *Gallinula chloropus* in the South Kashmir wetlands

Farooq Ahmad Bhat
Research Scholar, Department of Zoology, Faculty of Science & Technology, Mewar University, Chittorgarh, Rajasthan
Dr. Preeti Upadhyay
Assistant Professor, Department of Zoology, Faculty of Science & Technology, Mewar University, Chittorgarh, Rajasthan
Prof. (Dr) Mohammad Farooq Mir
Professor Zoology, Higher Education, J&K

Abstract

The study was carried out in three wetlands of South Kashmir viz Fashkoori, Manibugh and Chandhara-Kranchu during the breeding seasons of 2018 & 2019 focusing on the incubation & survival rates of eggs of Common moorhen, *Gallinula chloropus*. The nests were searched and marked by long stakes flagged with green strips. The female arranged the eggs to ensure they were fully covered during the incubation and dedicated maximum time of the day for incubation, while the male remained nearby to protect the nests and eggs. The male incubated the eggs during night and when the female left the nests for feeding. The female continuously rearranged the eggs for uniform incubation, completing the process within 17 to 22 days. Hatching success rate was influenced by presence of dense, tall vegetation and number of predators, with Fashkoori wetland has highest predation loss at 16.85%, while Chandhara-Kranchu has the greatest loss due to the faulty incubation at 20.63%. Overall, 15.87% eggs were lost by predators and 19.23% eggs by faulty incubation. Hatching was asynchronous with slight variation in hatching success rates during two years of study i.e. 65.09% in 2018 and 64.71% in 2019, resulting in an average success rate was 64.90%.

Key Words: Common Moorhen, Incubation, Hatching, Predators, Faulty Incubation.

Introduction

The Common moorhen, *Gallinula chloropus* or swamphen belongs to rail family of the order Gruiformes typically inhibiting in well-vegetated ponds, marshes, swamps, wetlands and canals. It consumes wide variety of plant and animal matter as food while walking on marsh land and upending while swimming in water. The bird is distributed worldwide, except in Polar Regions and high altitudes in northern hemisphere. However, it prefers mostly the regions that have plenty of submerged weeds, floating vegetation, reeds and rushes. It is an adaptable species, able to spread its population quite rapidly and colonize a wide range of habitats. It's long beak, legs and narrow body enable it to thrive among tall vegetation.

The bird is a sexually monomorphic, breeds in wetlands of Kashmir. It's breeding season occurs from May to August, during which it selects nesting sites within densely vegetated areas primarily composed of *Typha angustata*, *Sparganuim ramosum* and *Phragmites communis*. During, breeding season, it performs various breeding activities, produces relatively young ones, and made

them adaptable to live in aquatic, semi aquatic and terrestrial habitats. The bird is territorial, both male and female establishes territories and defends it by aggressive postures and fights. Incubation is carried out by both male and female (Siegfried and Frost, 1975) and completed within 21 days (Wood, 1974).

The study was conducted in three South Kashmir wetlands that will provide valuable insights into the incubation and hatching success rates and shedding light on the factors influencing egg loss of Common Moorhen. The findings could be instrumental in developing conservation strategies to improve nesting success and mitigate threats in these wetland habitats.

Materials and Methods

The nests were searched among the dense vegetation during the breading season of April/May by focal observation or noticing the nesting behavior through field binocular 10x50 following standard procedure. Various nests were found, however, only those nests were selected for intensive study that were easily accessible. The nest sites were marked by long stakes flagged with green strips to relocate the nests. During the period of egg laying, nests were monitored on alternative days, however, sometimes regularly and eggs were counted in each nest under observation. Incubation behavior was studied from morning to evening at a distance of about 10 to 15 meters away from nest. To avoid disturbance sometimes field binocular 10 X 50 was used to study the incubation behavior. Hatching period was the number of days over which all eggs in a clutch hatched. Hatching success was calculated as:

$$\frac{\text{Total no. of eggs hatched}}{\text{Clutch size}} \times 100$$

Hatching success highlights effectiveness of incubation and potential impact of the factors on hatching rates.

Study sites

The study was conducted to examine the incubation and hatching rates of the significant breeding bird, the Common Moorhen (Gallinula chloropus), across three wetlands in South Kashmir. The wetlands were selected on the basis of their vegetation, water level, impact of natural and anthropogenic pressure.

Fashkoori wetland: - Fashkoori wetland is situated in the town of Pampore, encompassing an area of 15.25 hectares. It is geographically positioned between the coordinates 34° 1.022'N 74° 55.274'E and 34° 0.592'N 74° 55.319'E, completely encircled by the urban development of Pampore. This wetland is characterized as a permanent shallow water body, receiving its water supply from channels originating from the springs of the nearby Wastoorvan mountains. The predominant feature of the wetland is its open water, which supports a diverse array of flora and fauna.

Fig. 1 GPS view of Fashkoori wetland

Manibugh wetland: - Manibugh wetland is located near Galandar village, southeast of Pampore town in the Pulwama district of Jammu and Kashmir. Covering an area of 7 hectares, it is positioned between the coordinates 34° 0.111'N 74° 55.812'E and 33° 59.897'N 74° 55.595'E, at an elevation of 1588 meters. The wetland is in close proximity to the Government Degree College Pampore and the HP gas plant, with three sides bordered by saffron karewas and the western side adjacent to paddy fields, featuring a significant expanse of open water interspersed with patches of vegetation.

Fig. 2 GPS view of Manibugh wetland

Chandhara-Kranchu wetland: - The wetland is situated on the left side of the Srinagar-Jammu highway, characterized as a permanent shallow water body encircled by rice and saffron fields. It lies at a latitude of 33° 45' 2" N, adjacent to National Highway-44 (NH-44), and derives its name from the

nearby villages of Chandhara and Kranchu. Covering an area of 6.40 hectares, the wetland is primarily replenished by springs and the agricultural runoff from approximately ten surrounding villages. Initially designated for preservation in 1945, it was upgraded to a conservation reserve in 1978 and came under the jurisdiction of the Wildlife Protection Department in 2013.

Fig. 3 GPS view of Chandhara-Krenchu wetland

All the three wetlands have diverse long and dense macrophytes, consists of emergent (*Typha angustata, Sparganium erectum, Phragmites communis, Ranunculus aquatilis, Carex phacota and Juncus articulate, Berula erecta, Polygonium hydropiper,* other submerged, rooted-floating Leaf Type and free floating. The tall stands of Typha create favorable conditions for various bird species to breed within the area. Additionally, numerous willow and poplar trees are present in and around these wetlands.

Results

The bird preferred to construct its nests among the dense vegetation 1-2 meters away from open water and 10-30 meters from disturbed areas. The female mostly remained active near the nest during the egg-laying period and visited the nest frequently. The female after completed the clutch, initiated the incubation with the removal of leaves or grass cover from the eggs. There were instances where an additional egg was laid after incubation had commenced. The female arranged the eggs to ensure complete coverage during incubation, spent most of her daytime on eggs, while the male took over the charge during the night. When the female was incubating, the male remained nearby to monitor and protect the nest from potential predators such as kites and crows. Sometimes the male climbed on nearby high altitudes or tree branches to monitor threats and displayed the aggressive behavior, calls in response to any threat. At several cases, sub adults and females emerged from their nests to help the male in defense by adopting aggressive postures. The male sometimes approached the intruders to keep them away. In two cases, it was recorded that kite

took away the eggs and caused slight destruction to the nests.During the period, when the female left the nest in search of food, the male took over incubation duties. Sometimes, both male and female left the nest for food without attending the eggs and spent some time away from the nests. In some cases, female covered the eggs by soft grass before leaving the nest for food. Upon returning from foraging, the female dried, cleaned the wings and legs, look here and there, resumed the incubation and continuously guarded the nests. After returned from feeding whether male or female made call "Kru" at a distance of 4 to 7 meters away from the nest, prompting the partner to leave the nest. It was noticed that the female before resumed the incubation, checked the nest carefully and rearranged the eggs by keeping the inner eggs outside and outer eggs at inner side. Throughout the incubation period, both the male and female actively rebuilt and repaired the nest as needed.

Fig. 4 Incubation

Fig. 5 Returning from feeding for incubation

Fig. 6 Hatching

The bird of the total day light from 6:00 am to 7:00 pm spent 70% time on eggs for incubation and with this the incubation period was found 17-22 days with the mean of 20.5 days.

Hatching occurred asynchronous, with its success rate influenced by predation, incubation conditions, and various environmental factors. In 2018, within the Fashkoori wetland, 6 out of 49 eggs were lost due to predation and 10 due to improper incubation. In the Manibugh wetland, 4 out of 28 eggs fell victim of predation, while 6 were lost by faulty incubation. Similarly, in the Chandhara-Kranchu wetland, 5 out of 29 eggs were lost by predation and 6 by incubation issues. In total, across 19 nests and 106 eggs, there were 15 losses attributed to predation and 22 to faulty incubation across all study sites.

In the 2019 study period, the Fashkoori wetland experienced the loss of nine out of 40 eggs due to predation and six eggs due to improper incubation. In the Manibugh wetland, four of 28 eggs were lost by predators, while five were lost by faulty incubation. Similarly, in the Chandhara-Kranchu wetland, five out of 34 eggs fell victim of predation, and seven were lost due to incubation issues. In total, across all three study sites, 18 eggs were lost by predation and another 18 by faulty incubation, resulting in a cumulative loss of 36 eggs from a total of 102.

Faulty incubation was the responsibility of the bird as the eggs were not properly turned during incubation, resultantly the eggs were not warmed up uniformly. However, predation was the main cause of the loss of eggs. The main predators were common crow, *Corvus splendens* and black kite, *Milvus migrans*.

In 2018, 33 out of 49 hatched from 8 nests showed the survival rate 67.35% in Fashkoori wetland. The Manibugh wetland had a survival rate of 64.29%, with 18 out of 28 eggs hatched from 6 nests, while Chandhara-Kranchu wetland saw a survival rate of 62.07%, with 18 out of 29 eggs hatched from 5 nests. In 2019, Fashkoori wetland's survival rate decreased to 62.5%, with 25 out of 40 eggs hatching from 7 nests. Manibugh wetland improved slightly to 67.86%, with 19 out of 28 eggs hatching from 6 nests, and Chandhara-Kranchu wetland recorded a survival rate of 64.71%, with 22 out of 34 eggs hatching from 7 nests. Overall, the hatching success rates were 65.09% in 2018 and 64.71% in 2019, resulting in a cumulative success rate of 64.90%.

Hatching success was high in the dense and tall vegetation due to the less impact of predators and human interference.

Chicks became visible with the removal of outer broken shell of the egg.

Table :1 Eggs lost by predation

Fashkoori wetland				
Year	**Nests**	**Eggs**	**Lost by Predators**	**Percentage**
2018	08	49	06	12.24%
2019	07	40	09	22.5%
Total	**15**	**89**	**15**	**16.85%**
Manibugh wetland				
2018	6	28	04	14.29%
2019	6	28	04	14.29%
Total	**12**	**56**	**8**	**14.28%**
Chandhara-Kranchu wetland				
2018	5	29	5	17.24%
2019	7	34	5	14.71
Total	**12**	**63**	**10**	**15.88%**

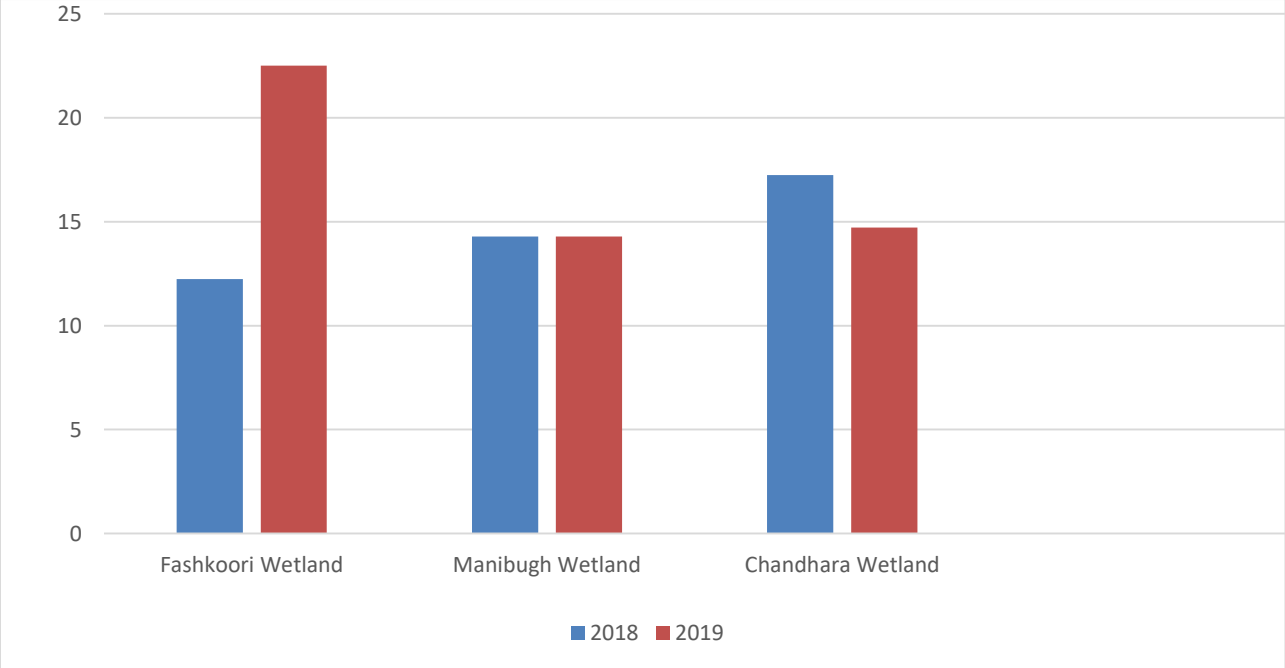

Fig.7: Eggs lost by predation

Table: 2 Eggs lost by faulty incubation

Fashkoori wetland				
Year	**Nests**	**Eggs**	**Lost by Faulty Incubation**	**Percentage**
2018	08	49	10	20.41%
2019	07	40	06	16%
Total	15	89	16	17.98%
Manibugh wetland				
2018	6	28	6	21.43%
2019	6	28	5	17.86%
Total	**12**	**56**	**11**	**19.64%**
Chandhara-Kranchu wetland				
2018	5	29	6	20.69%
2019	7	34	7	20.59%
Total	**12**	**63**	**13**	**20.63%**

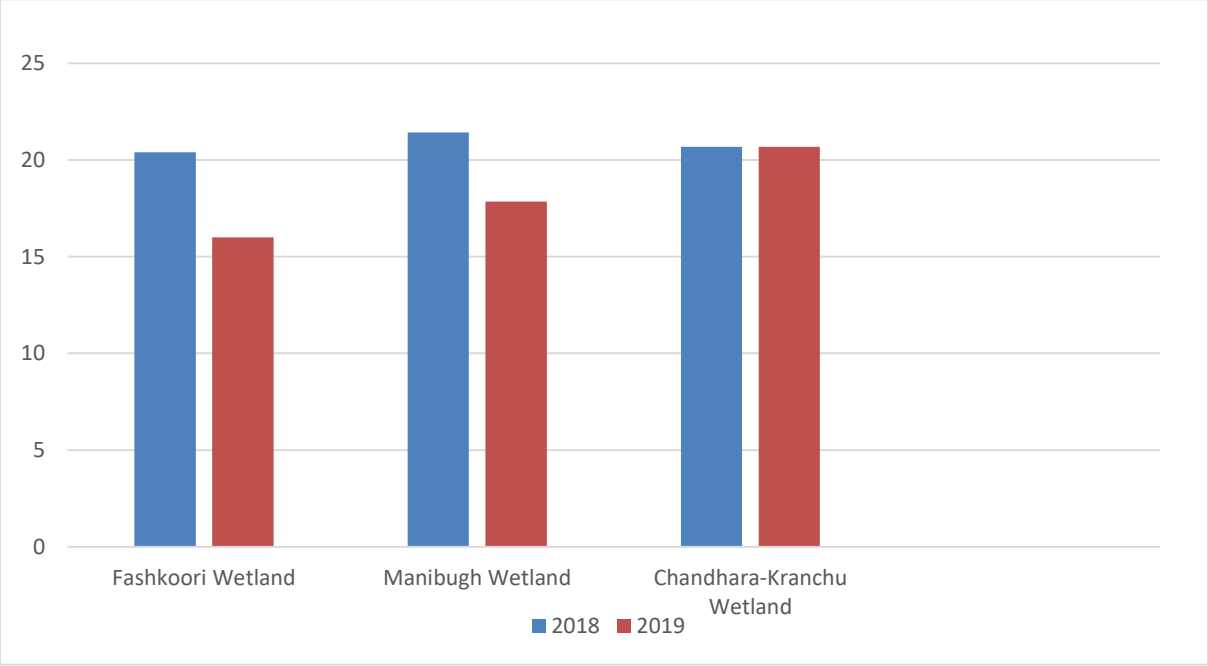

Fig. :8 Eggs lost by faulty incubation

Table: 3 Overall fate of eggs

Year	No. of Eggs Studied	No. of Eggs Hatched	%age	Eggs lost by Predation	%age	Eggs lost by faulty incubation	%age
2018	106	69	65.09%	15	14.16%	22	20.575%
2019	102	66	64.70%	18	17.65%	18	17.65%
Total	**208**	**135**	**64.90%**	**33**	**15.87%**	**40**	**19.23%**

Table: 4 Comparative hatching success

Study Area	Nests	Eggs	Total No. of Eggs Hatched	Percentage
2018				
Fashkoori wetland	08	49	33	67.35%
Manibugh wetland	06	28	18	64.29%
Chandhara-Kranchu wetland	05	29	18	62.07%
Total	19	106	69	65.09%
2019				
Fashkoori wetland	07	40	25	62.5%
Manibugh wetland	06	28	19	67.86%
Chandhara-Kranchu wetland	07	34	22	64.71%
Total	20	102	66	64.71%

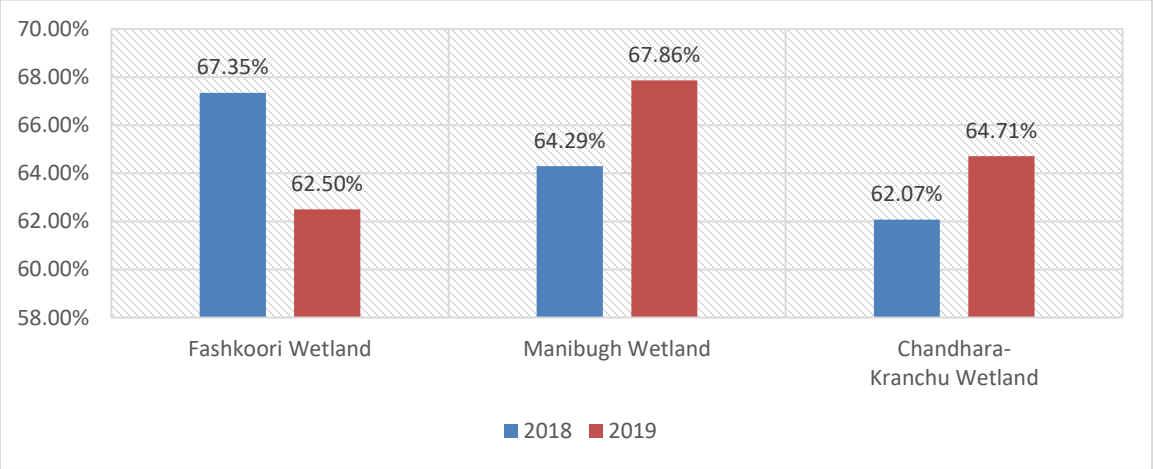

Fig.9 Comparative hatching success

Table 5: Overall hatching success

Year	Nests	Eggs	Eggs Hatched	Percentage
2018	19	106	69	65.09%
2019	20	102	66	64.71%
Total	39	208	135	64.90%

Discussion

After laying eggs, the female visits the nests frequently and resultantly started incubation. Similar observation was also made by Forman Daniel Willam (2001) who reported that Common Moorhen frequently visits its nests during egg-laying, incubation and hatching. The successful nests were visited more frequently as compared to non-successful ones. Incubation started after completion of the clutch, however, in few cases, it started early This was perhaps due to the risk of predation as reported by Persson & Goransson (1999) that initiation of incubation before clutch completion may be adaptive in areas of high predation risk by reducing exposure of eggs to potential predators. However, earlier McRae (1996) reported that early initiation of incubation is a counter measure against the parasitism. .

The male has been responsible for guarding the nests throughout incubation period, some times during morning both male and female left the nest for searching of food. Siegfried & Frost, (1976) reported the incubation is costly in moorhens and its rotation is related to clutch size. During the present study, it was observed that the female arranged, turned and rotated the egg to ensure the proper incubation throughout the incubation period. The turning and rotation of eggs was costly in case large clutches. The female was spending about 70% time on eggs for incubation during day and males was spending maximum time during night to ease the female perhaps due to reproductive hormones as Siegfried & Frost, (1976) also observed that males are actively involved in all aspects of parental care especially incubation. Wiebe et al. (1998) also reported that incubation behaviour is due to stimulation of reproductive hormones.

The incubation period ranged from 17 to 22 days, with an average of 20.5 days. This finding aligns with the reports of several researchers, including Steinbacher (1939), Witherby et al. (1941), and Brown (1944), who noted incubation duration of 19 to 22 days.

The eggs besides other factors lost by predation (15.87%) and faulty incubation (19.23%). The maximum loss of eggs by predators recorded in 2019 (17.65%). Nice, (1957), Wood (1974) and Martin (1988) earlier also observed that predation causes loss of eggs and according to him nest predation is a major source of egg loss in most avian species. Similar, finding in relation to egg lost by predators has been made by Martin (1991) and he reported that 44% egg lost by predations.

However, earlier Wood (1974) observed 14% and 16% success in clutch during 1968 & 1969 and according to him greater loss of eggs during 1968 was due to the floods.

Hatching was asynchronous. Similar finding was made by Lack (1968) who reported asynchronous hatching in moorhen and this occurrence is an adaptation to a variable food supply. In 2018, hatching success rate was 65.09% while in 2019, it was 64.71%, resulting, the overall success rate was 64.90%. This resembles with the finding of Huxley and Wood (1976) and according to them the hatching success was 65%. However, earlier to them Anderson (1965) observed 85% and Relton (1972) observed 56% of hatching success. M.F Fazil (2014) has reported that hatching success is higher in purple moorhens as compared to Common moorhens as the purple moorhen preferred nesting site in dense and tall vegetation.

Conclusion

The bird also seemed to select its nesting sites that minimized exposure to predators. Nests were positioned at distance from open water ranging from 1 to 12 meters and from disturbed areas at distance of 10 to 30 meters. It sometimes started the incubation before the completion of the clutch. The average incubation period was 20.5 days and during this period, eggs were lost by predators, human related activities, natural events. and faulty incubation. Despite the loss of the eggs, the hatching success rates were 65.09% in 2018 and 64.71% in 2019, resulting in an overall success percentage of 64.90% reflecting that hatching success remained consistent across both years and sites with minor variations attributed to predation and incubation faults. Asynchronous hatching could be an adaptive strategy in moorhen, allowing some chicks to hatch even if environmental conditions or predation pressure reduce clutch success. Also, predation and faulty incubation were identified as primary challenges to hatching success, suggesting a need for better habitat management and conservation strategies to mitigate these risks.

References

1. Alvarez, F. Sanchez, C. Angulo, S. (2006). Relationships between tail flicking, morphology and body condition in moorhens. *Journal Field ornithology*, 77:1-6.
2. Bannor, B. K. and E. Kiviat (2002). Common moorhen (*Gallinula chloropus*). *The Birds of North America*. 685: 1-27.
3. Bashir, S., Azra N., Kamili and M. A. Shah (2017). Habitat preferences and nesting ecology of Indian Moorhen (*Gallinula chloropus*) in lakes and wetlands of Kashmir Valley. *Journal of Research and Development*, 17:81-85.
4. Bates, R. S. P. and Lowther, E. H. N. (1952). Breeding birds of Kashmir. *Oxford University Press, London.* p 367.

5. Fazili, M. F. and Humera I. (2013). Nest site selection and breeding parameters of common moorhen in Hokersar wetland Kashmir. *International Journal of Current Research*. 5(6) 5161-1564.
6. Fazil, M. F. (2014). Comparative study of reproductive biology of Moorhen inhabiting Hokersar Wetland Kashmir. *Global Journal of Current Research*. 2(3): 47-50.
7. Foraman, D W. Brain PF. (2004). Reproductive strategies used by Moorhens (Gallinula chloropus) colonizing an artificial wetland habitat in south Wales. *Journal of Natural History*, 38:389-401.
8. Harato, T. , (1989). Breeding biology and social structure of the Moorhen, *Gallinula chloropus*. *Behav. Ecol. Sociobio*. 19: 221-232.
9. Hoyt, D. F. (1979). Practical methods of estimating volume and fresh egg weight of birds eggs. *Auk*. 96(1): 73-77.
10. Karhu, S. (1973). On the development stages of chicks and adult moorhens, *Gallinula chloropus* at the end of breeding season. *Ornis Fennica.* 50: 1-17.
11. McRae, S. B. (1996b). Brood parasitism in the moorhen brief encounters between parasites and hosts and the significance of an evening laying hour. *Journal Avian Biology*. 27:311-320.
12. Meniaia, Z. , Samraoui, F. , Alfarhan, A. H. and Samraoui, B. (2014).Nest site selection, breeding success and brood parasitism in the common moorhen, *Gallinula chloropus* in Algeria. *Zoology and Ecology.* 24:305-313.
13. Relton (1972). Breeding biology of Moorhen on Huntingdonshire farm ponds. *Brit. Birds.* 65:248-256.
14. Siegfried, W. R. and P. G. H. Frost, (1975). Continuous breeding and associated behavior in the moorhen, *Gallinula chloropus*. *Ibis.* 117.
15. Wood, N. A. (1974). The breeding behavior and biology of the moorhen. *Brit. Birds*. 67:104-115.