



ECOLOGY OF SWAMPHEN, *PORPHYRIO PORPHYRIO* (GRUIFORMES: RALLIDAE) POPULATION IN KUKKARHALLI LAKE, MANASAGANGOTRI CAMPUS, MYSORE, INDIA

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Abstract

Systematic field investigations were made on weekly basis by following an all out search method and variable width line transect method to record the habitat conditions and normal activities of swamphen, *Porphyrio porphyrio* (Gruiformes: Rallidae) in Kukkarhalli Lake, Mysore, Karnataka during 2019-2020. *P. porphyrio* is living safely with the prevailed habitat conditions and has shown normal activities such as preening, resting, roosting, foraging, chasing, running, flying, fighting, swimming, voice making amidst urban Lake of Mysore. Presence of birds in urban Lake indicates the prevalence of suitable conditions in water and aquatic birds normal activities indicating the healthy status of water. Simple field observations on water birds housed with the Lake water system would help indicate the normal ecological conditions suitable to host diversified avifauna and necessitated the preservation of such Lake ecosystems in urban area.

Keywords: *Porphyrio porphyrio*, Kukkarahalli Lake, Mysore.

INTRODUCTION

Aquatic birds are the most important integral part of every aquatic ecosystem. Few bird species becomes a part of different tropic levels and useful in up keep the aquatic ecosystems in an healthy way. The grey headed swamp hen, *Porphyrio porphyrio* (Ali, 1941) also known as 'Purple Swamp Hen' or 'Purple Moorehen' or 'Purple Gallinule' or 'Purple Coot' is locally called 'Kaeneeli Neeru Koli' (Gruiformes: Rallidae) is a handsome leggy, purplish-blue rail with long red legs and toes. *P. porphyrio* inhabits the marshy area along with small to medium sized water habitats and distributed throughout the plains of India. Moreover, it lives in group and spend time in search of food sulking through the reed beds or awkwardly climbing up amongst and clinging to the stems of reed or grassy vegetation (Ali, 1941). It is a wetland specialist, nest, feed and roost in and around marshy wetlands (Bhupathy *et al.*, 1998 and Shraddha *et al.*, 2017). Since, wetlands hold immense ecological significance by providing suitable habitat to a good number of aquatic birds (Lakshmi *et al.*, 2020; Sujosha *et al.*, 2020; Satish *et al.*, 2020), housed with aquatic birds which occupy the position of top level consumers in aquatic food chain, food web and thus any changes in the habitat and food availability happens, it directly affects the survival of many bird species including *P. porphyrio*. Hence, aquatic birds are considered as indicators of wetland habitat conditions (Kushlan, 1978; Lakshmi *et al.*, 2020; Sujosha *et al.*, 2020; Satish *et al.*, 2020). Further, wetlands are shallow water areas which act as transitional zones between terrestrial and aquatic systems (Cowardin *et al.*, 1979; Mitsch and Gosselink, 1986), support considerable amount of local biodiversity (Dudgeon *et al.*, 2006). Amongst aquatic birds, the *P. porphyrio* is considered as an indicator of wetland habitat conditions, where it live in marshes, lagoons, bogs, fens, mangroves, urban lakes and other open water habitats, which are at greater risk of habitat degradation due to various anthropogenic activities (Lakshmi *et al.*, 2020).

Bashir *et al.* (2017) and Basavarajappa (2007 and 2009), Shruthi and Basavarajappa (2016) have recorded the bird species composition regulated more by human activity than by plant community composition and that the bird communities were a better choice than the plant communities to index the effect of human disturbance. Therefore, *P. porphyrio* was considered during the present study to understand the effect of human disturbances on this species and its habitat. However, *P. porphyrio* like other aquatic birds also plays an important role in pollination, dispersal of seeds, insect predation, food chain balancing etc, amidst aquatic ecosystems (Sharma *et al.*, 2014), reports on this species is not available and as it is one of the commonly occurring species in Kukkurahalli Lake. Furthermore, biology of *P. porphyrio* was studied by Menon (2005) in Azhinhillam wetland, Kerala. The habitat selection and behaviour of *P. porphyrio* in Ambala District of Haryana State was conducted by Rana (2018). The flocking activity of aquatic birds indicates the anti-predatory tactics among many bird species with increasing group size (Menon, 2005). Rana (2018) has recorded the vocal call by display and unique body posture in *P. porphyrio*. Published reports on *P. porphyrio* inhabitation and its habitat conditions in Lakes located amidst urban environment are sparse. Moreover, the aquatic bird species living in urban Lakes are facing severe threat due to various reasons (Lakshmi *et al.*, 2020). Sujosha *et al.*, 2020 have reported on different aquatic bird species in different Lakes of Mysore. However, there are no published reports exclusively on *P. porphyrio* in this part of the State. Therefore, to assess the habitat conditions and to record the normal activities to reveal the status of the *P. porphyrio* and its habitat conditions, present study was undertaken.

MATERIALS AND METHODS

Study Area

In Mysore, >100 years old prominent 'University of Mysore' was established in 1916. The Manasagangotri is the main campus of this University that lies 12°18'28.33"N and 76°38'21.75" E at an elevation 2,479.4 ft above msl (Kamath, 2001).

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The University campus is spread with >800 acres geographical area with well grown avenue trees, neatly maintained lawns, ground vegetation with CCTV surveillance within in the center of Mysore city (Anonymous, 2020; Nagaraj, 2020). Amidst Manasagangotri campus, Kukkarahalli Lake is with with 62 ha water body spread area. The has a shore length of five kilometres and is one of the urban lung spaces of Mysore city. The Lake is housed with vast variety of microorganisms, plants and animals which help maintain the local biodiversity.

Methodology

After earmarking five observation sites at different regions of Kukkaralli Lake, 100 meters variable width line transects were permanently fixed at all the sites to conduct systematic survey on weekly basis during 2019 and 2020. Two to three visits were made in a week by following standard methods (Basavarajappa, 2006; Shruthi and Basavarajappa, 2016). *P. porphyrio* was observed during early morning i.e., 6.30 to 8.00 AM and in the evening i.e., 4.00 to 5.30 PM by following an all out search method. Visual point count method was adopted and at each observation site minimum five to ten minutes were spent to record the birds and their normal activities using Krevia Comet 8 × 40 mm binocular and also through naked eye.

Statistical Analysis

The collected data was compiled by following standard methods (Basavarajappa, 2006; Shruthi and Basavarajappa, 2016). The population density, percent occurrence, analysis of variance (ANOVA) and correlation coefficient was used as per Saha (2009).

RESULTS

Population Density of *P. Porphyrio*

The swamphen, *P. porphyrio* was recorded at different sampling sites which are covered with herbs, shrubs and trees amidst Kukkarahalli Lake. The population density of *P. porphyrio* in Kukkarahalli Lake during different months are shown in Table 1. Comparatively, the population density was high during evening hours than morning hours. Further, analysis of variance of *P. porphyrio* population density differed significantly ($F=87.3$; $P>0.01$) during morning and evening hours in Kukkarahalli Lake and indicated that *P. porphyrio* population density was not even during different hours in a day (Table 1).

Percent Occurrence

The percent occurrence of *P. porphyrio* during different months in Kukkarahalli Lake is shown in Table 2. The February month had highest population (58%) and it was followed by March (21.3%) and January (17%). However, during November and October, the *P. porphyrio* population was <3% (Table 2). Further, percent occurrence of *P. porphyrio* during morning and evening hours is shown in Table 3.

Correlation Coefficient

Table 4 shows the correlation coefficient of *P. porphyrio* population during morning and evening hours in Kukkarahalli

Lake. Surprisingly, the 'r' value indicated that there was no correlation existed between the *P. porphyrio* population recorded during morning and evening hours in Kukkarahalli Lake (Table 4).

Table 1. Population of *Porphyrio porphyrio* in Kukkarahalli Lake

Month	Sl. No.	Week	No. of birds recorded during	
			Morning	Evening
October	1.	3 rd	-	8
	2.	3 rd	-	7
November	3.	3 rd	-	7
	4.	3 rd	-	12
	5.	4 th	5	8
January	6.	4 th	5	10
	7.	4 th	-	20
	8.	5 th	7	34
	9.	1 st	9	27
	10.	1 st	11	20
February	11.	2 nd	16	31
	12.	2 nd	-	29
	13.	2 nd	20	20
	14.	3 rd	18	18
	15.	3 rd	-	25
	16.	4 th	17	13
	17.	4 th	26	-
	18.	5 th	19	26
March	19.	1 st	19	29
	20.	1 st	28	18
	21.	2 nd	15	18
Mean			10.23	18.09
'F' value			87.30*	

Note: Each value is a mean of 21 observations.

* Value is significant at 0.1% level.

Table 2. Percent occurrence of *Porphyrio porphyrio* during different months

Sl. No.	Month	% Occurrence
1.	October	1.3
2.	November	2.4
3.	January	17.0
4.	February	58.0
5.	March	21.3
Total		100.0

Note: Data is based on Table 1.

Table 3. Percent occurrence of *Porphyrio porphyrio* during morning and evening hours

Week	% Occurrence of birds during		Total
	Morning	Evening	
1.	-	1.3	1.3
2.	-	1.2	1.2
3.	-	1.2	1.2
4.	-	2.0	2.0
5.	0.8	1.3	2.1
6.	0.8	1.7	2.5
7.	-	3.4	3.4
8.	1.2	5.7	6.9
9.	1.5	4.5	6.0
10.	1.8	3.4	5.2
11.	2.7	5.2	7.9
12.	-	4.9	4.9
13.	3.4	3.4	6.8
14.	3.0	3.0	6.0
15.	-	4.2	4.2
16.	2.9	2.2	5.1
17.	4.4	-	4.4
18.	3.2	4.4	7.6
19.	3.2	4.9	8.1
20.	4.7	3.0	7.7
21.	2.5	3.0	5.5
Total	36.1	63.9	100.0

Note: Data is based on Table 1.

Table 4. Correlation coefficient of *Porphyrio porphyrio* population during morning and evening hours

Week	Morning	Evening
1.	-	8
2.	-	7
3.	-	7
4.	-	12
5.	5	8
6.	5	10
7.	-	20
8.	7	34
9.	9	27
10.	11	20
11.	16	31
12.	-	29
13.	20	20
14.	18	18
15.	-	25
16.	17	13
17.	26	-
18.	19	26
19.	19	29
20.	28	18
21.	15	18
Mean	10.23	18.09
'r' value	0.092	

Note: Each value is a mean of 21 observations.

Normal activities of *P. porphyrio*

P. porphyrio are generally found in small groups and studies have shown that these consist of more males than females. More than one male will mate with a single female. All family members including the young individuals share in incubation and care of the developing young. The nest consists of a platform of trampled reeds with the surrounding vegetation sometimes being used to form a shelter. Often two broods will be raised in a year. This is followed by preening, resting, roosting, foraging, running, chasing, screeching, flying, bathing, swimming, fighting are few normal activities recorded during the present investigation.

Preening

Preening activity observed in *P. porphyrio* is shown in Table 5. After a bath, the *P. porphyrio* walked up on a dead branch for an extended preening session. It spread wings and shake them from side to side to dry out. The preening activity is performed to clean their feathers with the help of beak. Moreover, *P. porphyrio* uses both legs to scratch the neck and the head regions, the wings were lift upward and side-down ward during cleaning its body. After preening, feathers were rumpled and shaken the wings. Further, preening activity was high during evening hours compared to morning and noon (Table 6). Since morning, it is busy with foraging activity till evening before going to its nesting site to take shelter at night. Before that it conduct preening to clean its body. Perhaps, this might be one of the reasons for more preening activity during evening hours.

Roosting and Resting

P. porphyrio prefers silent place which is devoid of any animals including human beings. It roost and rest on/under small to medium sized shrubs or herbs and in bushy tall reedy vegetation. Table 5 shows the number of *P. porphyrio* observed in roosting and resting during the present study. It was interesting to note that majority of the individuals were busy in roosting and resting during noon hours. They never get

into the field. Perhaps, high temperature prevailed during noon might have discouraged these birds to appear in the field for foraging. The male *P. porphyrio* rest in between the grasses and sometimes on a low hanging branch of the tree also. Sometimes, it walks by flicking its tail up and down on the submerged vegetation.

Table 5. Normal activities of *Porphyrio porphyrio*

Sl. No.	Activity	No. of birds involved	% Occurrence
1.	Preening	23	17.2
2.	Resting	11	8.2
3.	Roosting	07	5.2
2.	Running	09	6.7
3.	Foraging	53	39.6
4.	Chasing	11	8.2
5.	Vocal call	04	3.0
6.	Flying	10	7.5
7.	Bathing	03	2.2
8.	Swimming	02	1.5
9.	Fighting	01	0.7
Total		134	100.0

Note: Each value is a mean of 21 observations.

Running

Usually, running occurs when the *P. porphyrio* were startled and it was followed by flight. While running, *P. porphyrio* lift its wings and move with beating its wings fastly. Table 5. Shows the number of individuals exhibited running activity during the observation.

Foraging

Table 5 shows the number of *P. porphyrio* recorded during foraging. *P. porphyrio* is a omnivore, feeds on small birds, bird pullets, amphibians, small reptiles, fishes, eggs, insects, molluscks and terrestrial non-insect arthropods. Moreover, It feeds on the soft shoots of reeds, tubers and leaves. It also feed on small animals, such as frogs and snails. However, it is a reputed egg stealer and will also eat ducklings when it can catch them. *P. porphyrio* uses its long toes to grasp food while eating and exhibits solitary foraging activity. In Kukkarahalli Lake. *P. porphyrio* forage singly, though other individuals are often quite nearer to each other.

Chasing

Table 5 shows the number of *P. porphyrio* involved in chasing activity. Usually chasing occurs between the individuals of *P. porphyrio* and sometimes between the water ducks. While chasing, *P. porphyrio* lift its wings upwards and move instantly to a short distance and jump sometimes.

Screeching

Table 5 shows the number of *P. porphyrio* recorded in screeching during the present study. *P. porphyrio* screech when startled. Its screeching was continuous when startled. Table 5 shows the number of *P. porphyrio* showed specific vocal calls during the present study. Further, the vocal call was also performed more during evening hours compared to morning hours. Interestingly, there was no vocal call display exhibited during noon hours. The reason for this is not known. Similar type of observations was made by Rana (2018). The vocal call display with specific body posture by *P. porphyrio* is one of the unique behaviours, during threat or disturbance by the other bird species or human interference found at the vicinity of its territory.

Table 6. Preening and vocal call making activities of *Porphyrio porphyrio*

Sl. No.	Activity	During	Time	% Occurrence	Total % Occurrence
1.	Preening	Morning	6.40 to 6.55 AM	13.0	39.1
			7.00 to 8.00 AM	26.1	
		Evening	1.30 to 2.00 PM	4.4	56.5
			3.40 to 4.55 PM	30.4	
Total				100.0	100.0
2.	Vocal Call	Morning	6.45 to 7.05 AM	43.7	43.7
			4.13 to 5.00 PM	56.3	
		Total			

Note: Each value is a mean of 21 observations.

It also show variety of behaviours such as hooting, cackling and hoarse notes which are constantly heard with in reedy beds and bulrushes (Ali, 1941). They also screech while running or when threatened.

Communicaiton and Perception

P. porphyrio communicate visually and with vocalizations. Their calls are varied, including their shrieking warning and attack calls and their hummed courtship calls.

Flying

Flying activity occurred mainly while crossing Lake water between the shore area. *P. porphyrio* exhibited flight when startled and it was preceded by running. There was occasional flying between different sampling sites, as they were separated by 50 meters apart. Table 5 shows the number of *P. porphyrio* shown flying activity during the present study.

Bathing

P. porphyrio do bath and swim mainly at the edges of the Lake water. *P. porphyrio* never ventured into the deep water and this indicated its shore area preference which is little away from the reedy grasses vegetation. Moreover, *P. porphyrio* take bath by dipping its head and it was followed by the whole body dip in the water. It occurs two to four times followed by stepping out of the water and shaking its wings. Table 5 shows the number of *P. porphyrio* involved in bathing activity during the present study.

Swimming

P. porphyrio is a proficient swimmer, prefer to wander on the edges of the water, among reeds and on floating vegetation. Swimming is performed sometimes to reach the reedy grasses vegetation in the water. This was done when they couldn't walk on the submerged vegetation in the water. Table 5 shows number of *P. porphyrio* involved in swimming activity during the present study.

Fighting

P. porphyrio is a bulky bird and an accomplished flier, will readily take to the air to escape danger. In flight, the long legs and elongated toes trail behind or hang underneath the body. It is a type of defending activity exhibited when other bird species get into its terirot. Sometimes, it occurs when *P. porphyrio* is in group. A group include five birds. Moreover, not all the individuals in the group involved in fighting activity, only one or two individuals fight with each other and it usually occurs by pecking. Two birds pecked with each other by using wings perched upward, but not openly.

Table 5 shows the fighting activity of *P. porphyrio* individuals during the present study.

DISCUSSION

Porphyrio porphyrio is one of the members of the Rallidae family. It is a chick sized bird, male is larger than female and male weigh more (>1.0 Kg) than the female (~900 g). It has dark, shiny indigo or purple feathers and have red bills and frontal shields. The tails are short with bright white colour on the undersides of their tails (Ali, 1941 and Ali and Ripley, 1987). The breast and heads are from pale blue to purple blue. The legs are long, scaly and orange red (Balasubramaniam and Guay, 2008). It has mainly dusky black above with a broad dark blue collar and dark blue to purple below and has white undertail. The bill is red and robust. The legs and feet are orange-red in colour. *P. porphyrio* has a conspicuous white patch under the tail and the bald, red forehead with the heavy bill that confirms its identity (Ali, 1941). The sexes are alike and don't show variation in pumage but, males being slightly larger than females (Taylor, 1996 and Bertolero *et al.*, 2016). The juveniles are greyish when born and gradually develop the purplish tinge on their feathers. The juveniles and immature chicks have dull coloured plumage, bare parts than adults and can retain some grey body feathers, typical of the juvenile plumage, after their partial post-juvenile moult (Cramp and Simmons, 1980; Euring, 2010; Taylor, 1996 and Bertolero *et al.*, 2016). The red pate is absent in young chicks, but develop gradually as they age (Ali, 1941). *P. porphyrio* prefer freshwater swamps, streams and marshes with plenty of emergent vegetation. The vegetation includes sedges (*Carex* sp.) and reeds (*Phragmites* sp.), floating morning glory (*Ipomea aquatic*), pepper west (*Marsilea* sp.), cattail narrowleaved (*Typha* sp.), umbrella plant (*Cyperus* sp.). Its population was very less at sewage polluted water on the north-west side of Kukkarahalli Lake. The sewage water from the adjoining Padavarahalli area, where residential sewage is releasing every day into the north-west side of Kukkarahalli Lake. Due to sewage pollution, the north-west side of Kukkarahalli Lake is completely covered with tall grass and other submerged vegetation. This region is totally devoid of open water and exhibiting fowl smell. However, this region is separated by putting mud bund to avoid the entry of sewage to main water body of Kukkurahalli Lake. Constant efforts are made by University authorities to avoid the sewage pollution. During rainy season, sewage is diluted due to rainfall runoff, but during summer, when the water level decreases in the Lake, sewage problem prevails. Besides, at the west, south and east side shore area the *P. porphyrio* population density is good and during most the days in a year, *P. porphyrio* are commonly occurs in Kukkurahalli Lake. Further, the habitat of *P. porphyrio* could be divided into two main zones that is the central core zone characterized by abundant vegetation, high

water level and difficult accessibility and the peripheral buffer zone, which is characterized by abundant vegetation due to low water level and easy accessibility (Basavarajappa and Vijayan, 2012; Rana, 2018). The *P. porphyrio* is omnivore (Helm *et al.*, 1987; Reagan, 1977), feed on rice plants and other aquatic plants by cutting stems with its strong beak and manipulating the food skilfully with their digits (Pellis, 2011 and Morenopo and Pique, 2018). Foraging, preening, running and chasing activities primarily occurred on the shore area of Lake and indicated that *P. porphyrio* prefer to spend more time on the wet land surface compared in the water. This shows its amphibious habit. Further, *P. porphyrio* roosting was observed in the bushes. The submerged vegetation on the shore area of Kukkarahalli Lake offered primary habitat for *P. porphyrio*. The area is not much under human disturbance, as it is monitored and maintained by University of Mysore authority. However, the mixing of sewage/drainage water from residential areas at north-west region of Kukkarahalli Lake occurred, where the birds population was not found much. This indicated that *P. porphyrio* prefer unpolluted water conditions for its normal survival. The pollution is not only affect the normal activity of *P. porphyrio* but, it also affect the other biotic components of Lake water. Our observations are on par with the observations of Menon (2005), Balasubramaniam and Guay (2008), Pellis (2011), Bertolero *et al.* (2016), Bashir *et al.* (2017), and Rana (2018). Further, wetlands are commonly associated with Lakes and can occur as isolated features of the landscape (Shraddha *et al.*, 2017). They are among the world's most productive environments, rich in biodiversity, provide the water and productivity upon which countless species of plants and animals depended for their survival (Kumar and Gupta, 2009). Moreover, wetlands support diversified avifauna including *P. porphyrio*. Wetlands directly or indirectly help restore the local biodiversity and human survival. Therefore, wetlands are indispensable for the countless benefits. The ecosystem services they provide ranging from fresh water supply, food, ground water recharge, local weather change, supporting migratory birds, provide scientific knowledge on local biodiversity, recreation and tourism (Weller, 1999; Prasad *et al.*, 2002 and Shraddha *et al.*, 2017). Therefore, lakes in urban environment playing a key role, acts like lungs of urban ecosystem. Moreover, *P. porphyrio* is enlisted under category of Least Concerned species as per Wildlife Protection Act (1972), hence, its preservation is essential. Our observations are on par with the observations of Bashir *et al.* (2017) and Basavarajappa (2007), Shruthi and Basavarajappa (2016) Sujosha *et al.* (2020) and Satish *et al.* (2020).

CONCLUSION

Every bird species living in aquatic habitats exhibit specific activities, which reflect on the healthy status of such birds population and return its habitat. The preening, resting, roosting, foraging, running, chasing, screeching, flying, bathing, swimming, fighting are few normal activities unique to *P. porphyrio*. Although *P. porphyrio* hen is under the category of Least Concerned species as per Wildlife Protection Act (1972), if the prevailing conditions continue to operate on the existing population in Kukkarahalli Lake, it would affect not only the *P. porphyrio* population but, also other water bird species. The Kukkarahalli Lake is an urban Lake, important to both humans, aquatic avifauna and local biodiversity. Therefore, within the purview of Wildlife Protection Act (1972), strengthen the existing rules further to protect the

existing avifauna in general and *P. porphyrio* in particular in Kukkarahalli Lake for future generation.

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