

**FORAGING EFFICIENCY ALONG WITH FORAGING METHODS UTILIZED BY  
LITTLE EGRET (*EGRETTA GARZETTA*) IN DIFFERENT HABITATS OF JAMMU  
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**ABSTRACT**

The foraging efficiency and foraging methods of Little Egret *Egretta garzetta* were studied during March 2013 to February 2016 by direct observation of individuals foraging in various habitats of Jammu. "Walk Slowly" (40.72%) was discerned to be their most common and preferred method of foraging followed by "Stand and Wait" (31.13%) and juveniles of Little Egret were less successful than adults in foraging. Most preferred habitat utilized by Little Egret was Lentic followed by lotic. Karl Pearson correlation coefficient was also deduced between various foraging variables which showed positive correlation between average pecks and successful attempts ( $r = 0.548$ ,  $p < 0.05$ ) in open agricultural fields by adults. Lentic, lotic and urban habitats also recorded positive correlation viz., ( $r = 0.427$ ,  $p < 0.05$ ), ( $r = 0.390$ ,  $p < 0.05$ ) and ( $r = 0.098$ ,  $p < 0.05$ ) respectively between average pecks and successful attempts of adults.

**KEYWORDS:** Little Egret (*Egretta garzetta*), foraging efficiency, foraging methods, habitats and correlation.**INTRODUCTION**

In ornithology, many studies of feeding behaviour or foraging strategies rely on the monitoring of bird activity rhythms (Hutto, 1981; Biermann and Sealy, 1982; Johnson and Best, 1982). The method used by a bird to search for food determines how and which kind of prey they will encounter, which ultimately reflects different foraging tactics employed by a species. In considering any species feeding ecology, the most important factor upon which an individual is dependent for survival and success; is its efficiency in feeding. Apart from choosing the good feeding habitat, reckon with the food availability there, birds must improve/increase their foraging efficiency not only to be successfully able to cope up with their needs as well as the requirements of their growing chicks but also to thrive well with other co-existing species with similar ecological requirements.

Little Egret (*Egretta garzetta*) belonging to family Ardeidae of Order Pelcaniformes is commonly seen wading bird which occur in major parts of the Indian sub-continent except parts of northwest, northeast and Himalayas (Grimmett *et al.*, 1998). The aim of this study was to generate information on the foraging efficiency and various foraging methods utilized by adults and juvenile of Little Egret in various habitats of Jammu and to see the relationship between various foraging variables.

**MATERIAL AND METHODS****Study area**

The Jammu city sprawls on both the banks of river Tawi which is a tributary of river Chenab. The old city is confined to the right bank while the later expansions of the city have largely taken place on the left bank with few new colonies on the right bank also. Large scale urbanization and industrialization has given rise to what is now called Greater Jammu, the name given to the old, new and the suburbs of Jammu. Geographically, it lies between 32°27' and 33°30'N latitude and 74°19' and 75°20' E longitudes and at an altitude of 275 m to 410 above mean sea level. There is a vast variation in the physiology of Jammu region, so the study area was broadly divided into various habitats which were further categorized into various sub-stations.

**STATION I: OPEN AGRICULTURAL FIELDS:**

This habitat included five (05) sub stations namely:

1. **R. S. Pura area:** This station is located at 32°78'69" N latitude and 74°54'42" E longitude and at an altitude of 270 m above mean sea level. The area is an agricultural belt known for rice and wheat as its major crops while mustard, barseem and vegetables are also grown. The area has various natural and artificial water bodies in the form of irrigation canals, marshes, ditches, irrigated agricultural fields and the world famous Gharana wetland.

2. **Haripur:** It is village in R.S. Pura tehsil and is in the border of the Jammu district and Samba district. It is located 26.2 km from district Jammu.
3. **Kalyana:** It is situated at latitude 32.4962763 N and 74.736626 E longitudes.
4. **Bishnah:** This station is located 32°62'N latitude and 74°87' E longitude, at a distance of 14 km from Jammu city. It is located at an altitude of 292 km.
5. **Salehar:** It is located between 32°33'39" N latitude and 74°49'16" E longitude with an elevation of 263.4 m above msl and is at a distance of 14 km from Jammu city.

**STATION II: LENTIC HABITAT:** Three sub stations were selected for this particular habitat and these are:

1. **Lake Mansar:** The Lake is sub-oval shaped and subtropical freshwater warm monomictic lake covered by forest covered hills. It lies between 32°41' 48.36" N latitude and 75°08' 44.70" E longitude at an elevation of 666 m above msl and is located at a distance of 65 km east of Jammu city.
2. **Lake Surinsar:** It is about 40 km North-east of Jammu city with a latitude of 32°46' 07.90" N and longitude of 75°02' 28.48" E with an altitude of 605 m above msl.
3. **Gharana Wetland:** Known as paradise for bird watchers, the Gharana wetland situated near Indo-Pak international border in R. S. Pura tehsil is one of the important wetland reserves of Jammu region. It is located about 35 km South of Jammu city and is positioned at latitude 32°32'26" N and longitude 74°41'24" E with an altitude of 350 m above msl. The marshy area of wetland is surrounded by village Gharana on its one side and agricultural fields on the other sides.

**STATION III: LOTIC HABITAT:** Four sub stations were included in this habitat:

1. **River Tawi:** It lies between 32°35'-33°5' N latitude and 74° 35'-75 ° 45' E longitudes. Basically, it originates from Dhaulandhar range, a branch of the Central Himalayan axis below Seoj Dhar peak, from the lapse of Kali Kundi glacier and the adjoining area of Southwest of Bhaderwah in Doda district.
2. **Gho-Manhasan Stream:** The stream is a tributary of River Chenab. It is located between 32.56° N latitude and 74.95° E longitude in district Jammu. The stream is flanked by rich macrophytic vegetation and supports a great diversity of both flora and fauna. It is located at a distance of about 12 km from Jammu city.
3. **Ditch Rakh:** It is positioned at a latitude of 32°36'27.56" N and a longitude of 74°43'57.29" E with an elevation of 271 m above mean sea level. It is at a distance of 31 km from Jammu city. Along with Gharana wetland, this army ditch also provides a suitable habitat to various migratory and resident aquatic birds.
4. **River Basantar:** It is located in district Samba of Jammu division and is a source of water supply to

the Samba town. It is a tributary of River Ravi and originates from Shivalik hills of Jammu and finally flows down towards Pakistan territory. It is positioned at 32°34'11.06" N latitude and 75°06'17.91" E longitude and is located at an altitude of 356 m above mean sea level. It is about 38 km from Jammu city.

**STATION IV: Urban Habitat:** This included following two sub stations:

1. **Nai Basti:** This station lies between 32°41' 31.76" N latitude and 74°50' 54.52" E longitude. It is situated at distance of 5km from the Jammu city.
2. **Jewel:** It is located between 32°43'32" N latitude and 74°51'23" E longitude and is in the centre of Jammu city. It is the busiest place surrounded by residential quarters, colleges, hotels, shops and is only 2.1 km away from city of Jammu.

#### METHODOLOGY

The data was collected for three consecutive years from March 2013 to February 2016. Periodic surveys were performed in the area under inquisition from 0630 hr to 1200 hr in the morning and 1300 hr to 1900 hr in evening during summer and 0730 hr to 1200 hr in morning and 1400 hr to 1830 hr in evening during winter.

The observations were taken on their foraging behaviour using "Focal Animal Sampling" technique.

#### Equipments used

1. Binoculars (Bushnell 7 X 50 U. S. A. made).
2. Stopwatch.
3. Canon EOS camera fitted with 300 mm zoom lens
4. Digital Camera (Sony) fitted with 14.1 megapixel lens with an optical zoom of 10X.

#### RESULTS AND DISCUSSION

##### ➤ FORAGING METHODS

Little Egrets (*Egretta garzetta*) were noticed to feed both solitarily and in aggregations in the form of loose flocks which were less-coordinated at most of the study sites. Little Egrets mostly frequented lotic and lentic habitats and were spotted actively foraging in the agricultural fields during the months of June to September. The feeding strategy employed by a bird depends upon the nature of the prey, prey density and type of the habitat. Thus, feeding tactics used by Little Egret were classified into following categories: (Meyerricks, 1960 (a); Kushlan, 1976).

1. **Stand and Wait:** In this method, the bird stands motionless in water or on land waiting for prey to approach.

Two basic postures are recognized in it.

- **Upright Posture:** In this posture, the body is held erect, head and neck are fully extended angled away

from the body. This posture is used for scanning the area for predators.

- **Crouched Posture:** In this posture, the body is held horizontal to the perch or the water, legs are bent, and the head and neck are partially retracted.
- 2. **Walking Slowly:** The bird walking slowly and stalking the prey by taking few steps, characterizes this behavior.
- 3. **Foot Stirring:** The bird extends one leg forward, vibrates its leg and foot to disturb the prey or it vibrates its leg while wading forward normally. This motion stirs the area around its foot, thereby disturbing or attracting prey. Foot stirring can occur in mud, vegetation or water.
- 4. **Walking quickly:** The bird walks through shallow water or fields catching prey disturbed by its movements. It is a kind of disturb and chase behaviour.

During the course of study, Little Egrets were found to employ Walk Slowly, Walk Quickly and Stand and Wait foraging tactics most frequently. However, some instances of foot stirring feeding behaviour were also recorded. In Little Egrets, "Walk Slowly" (40.72%) was discerned to be their most common and preferred method of foraging. The probable justification is that that Little Egrets are active foragers, capturing their prey while on the move and hence mobility increases their chances of locating small, cryptic and sedentary prey apart from scrutinisation of the area. Similar feeding strategies were recorded by Hafner *et al.* (1982), Kazantzidis and Goutner (1996), Dimalexis *et al.* (1997) and Choi *et al.* (2008).

The other methods used by Little Egrets for foraging were "Stand and Wait" (31.13%), "Walk Quickly" (18.56%) and "Foot Stirring" (9.58%) (Table-1 and Fig.-2). However, Little Egrets were noticed to shift their feeding strategy to "Stand and Wait" while catering on the fast moving fishes as this strategy is beneficial and energetically efficient for Little Egrets to wait until the prey comes within its striking range. This finding is in agreement with that of Kushlan (1978), Kour (2009). In case of lentic habitat again "walk slowly" method was used as they were frequently seen foraging along the shores of lakes and water bodies in shallow water by employing this foraging strategy as it helps in the scanning of the area. Hafner *et al.* (1982); Kent (1986), Dimalexis *et al.* (1997) and Kour (2009) also recorded the same observations.

"Foot Stirring" feeding tactics was also recorded in Little Egrets in marshy habitats wherein it vibrated its feet to disturb the prey underneath thereby capturing it. This finding concurs with that of Kushlan (1976), Willard (1977), Hom (1983) and Kour (2009).

Thus, Little Egrets were found to exhibit plasticity in their foraging tactics in terms of mobility and prey preference. However, the most preferred feeding tactics

adopted by Little Egrets was observed to be "Walk Slowly" in lentic habitats although other feeding strategies were also employed depending upon the habitat type and prey availability. Similar observations were made by Hafner *et al.* (1982), Dimalexis *et al.* (1997), Recher *et al.* (1983) and Fasola (1986).

#### ➤ FORAGING EFFICIENCY OF ADULTS AND JUVENILES

During the present study, foraging efficiency of the Little Egret (*Egretta garzetta*) was assessed and comparative analysis of the foraging efficiency of adult and juvenile birds was also taken into account. Foraging efficiency can be defined as the number of capture per number of strikes.

It was observed that juvenile of Little Egret were less successful than adults in foraging. But they gradually improved their capture success with age. This view point is strengthened by the observations of various workers namely Recher and Recher (1969), Buckley and Buckley (1974), Cook (1978), Henderson (1984). Draulans and Van Vessem (1985) stated that lower efficiency of juveniles is due to the fact that juveniles undergo a period of maturation of motor and perceptual skills, although other proximate factors, such as competition between age classes, may also be involved. So, in order to improve their foraging skills, juveniles of Little Egret were noticed to feed in flocks of adults and tried to imitate them. Similar findings were given by Cezilly and Boy (1988).

It was noted that fledging or shortly thereafter, when parents no longer provision their young ones, juvenile birds were compelled to obtain most or all of their own food. During this period of transition to independence, young birds had to learn not only where to forage but also how to forage and this necessitated a learning period (which may be long) to be able to forage as efficiently as adults.

From, Table- 2 it is inferred that Juveniles were observed to take more number of steps, attempted more number of pecks and caught fewer items due to inexperience. Similar findings are given by Burger and Gochfeld (1989) and Kour (2009). Adults were found to take on an average of 12 steps per minute resulting in 4.5 of average items captured per minute successfully whereas on contrary, juvenile birds took on an average of 15.2 steps per minute with 3.5 items captured successfully in one minute. In addition to it, it was recorded that adults successfully captured highest number of food items (07) in case of lentic habitat followed by lotic and open agricultural fields (04 each) and least in urban habitat (03). However, juveniles of Little Egret were noticed to capture food items successfully in case of lentic habitat (06) followed by open agricultural fields (04), then lotic habitat (03) and least in urbanised habitat (01) (Table-2).

Although, adults and juveniles were normally found together in mixed flocks but postural patterns while foraging were different between the two age classes. Moreover, juvenile birds were observed to be less successful than adults at searching for and capturing prey as they were frequently discerned to capture and discard many objects that resembled the potential prey items like lumps of algae, floating twigs near the water bodies etc.

Furthermore, successful prey capture required high speed movements, precision and good visual motor co-ordination that was well developed in adults but poorly developed in the juveniles. But the fledglings were observed to improve their skills with practice and age. Moreover, the unsuccessful juveniles were observed to derive certain benefits by joining the feeding aggregations of the adults which included: a) the benefit of improving their capture success by imitating adults; b) the benefit of saving the time and energy to be spent in scanning for predators by relying on their conspecifics to detect any predator or disturbance while foraging thereby utilizing that time efficiently in foraging.

Scanning for predators was recorded to be at high level initially in juveniles foraging alone. Also, there was variation between the number of steps taken, number of prey captured and duration of foraging between adult and juvenile birds. In order to cope with their lower foraging success, juveniles were observed to forage for longer period of the day as when adult bird halted their foraging activity and rested during the mid day hours, juveniles were noticed to be involved in feeding, moving to different locations and pecking at any available prey thereby trying to improve their foraging skills.

#### ➤ Statistical Analysis

Karl Pearson correlation coefficient (r) (at 0.05 level, 2 tailed) was deduced between the foraging variables in

Little Egret (*Egretta garzetta*) in case of adults and juveniles (**Table-3**). The number of foraging attempts in adults was positively related to the number of steps ( $r = 0.650$ ,  $p < 0.05$ ) in case of open agricultural fields. However, the average number of pecks was also positively related to successful pecks ( $r = 0.548$ ) in the same habitat. On the other hand, in lentic habitat average steps of the adults depicted a positive correlation with average steps ( $r = 0.683$ ) and average number of pecks was also positively correlated to successful pecks ( $r = 0.427$ ). However, in lotic habitat, average number of steps in adults in two diverse habitats viz., Lotic and Urban showed negative correlation ( $r = -0.548$ ) and ( $r = -0.446$ ) respectively and average pecks was strongly positively related to successful pecks in lotic habitat ( $r = 0.390$ ) and weak positive relation in urban habitat ( $r = 0.098$ ).

In case of juveniles of Little Egret, positive correlation was recorded between average steps and average pecks ( $r = 0.429$ ) in open agricultural fields and a negative correlation ( $r = -0.167$ ), ( $r = -0.319$ ) and ( $r = -0.129$ ) was deduced between average pecks and successful pecks in case of juveniles in the three habitats viz., Lentic, Lotic and Urban respectively. Moreover, in open agricultural fields and lentic habitat, average pecks were found to be positively correlated with successful pecks i.e., ( $r = 0.031$ ) and ( $r = 0.118$ ) respectively. However, in lotic and urban habitat, average pecks showed negative relation with successful pecks with ( $r = -0.258$ ) and ( $r = -0.107$ ) respectively.

**Table-1: Repertoire of foraging methods adopted by Little Egret (*Egretta garzetta*) during the study period (2013-2014).**

S.NO.	METHODS	FREQUENCY	PERCENTAGE (%)
1.	Stand and Wait	52	----
(a)	Upright Posture	15	8.98
(b)	Crouched Posture	37	22.15
2.	Walking Slow	68	40.72
3.	Walking Quickly	31	18.56
4.	Foot Stirring	16	9.58

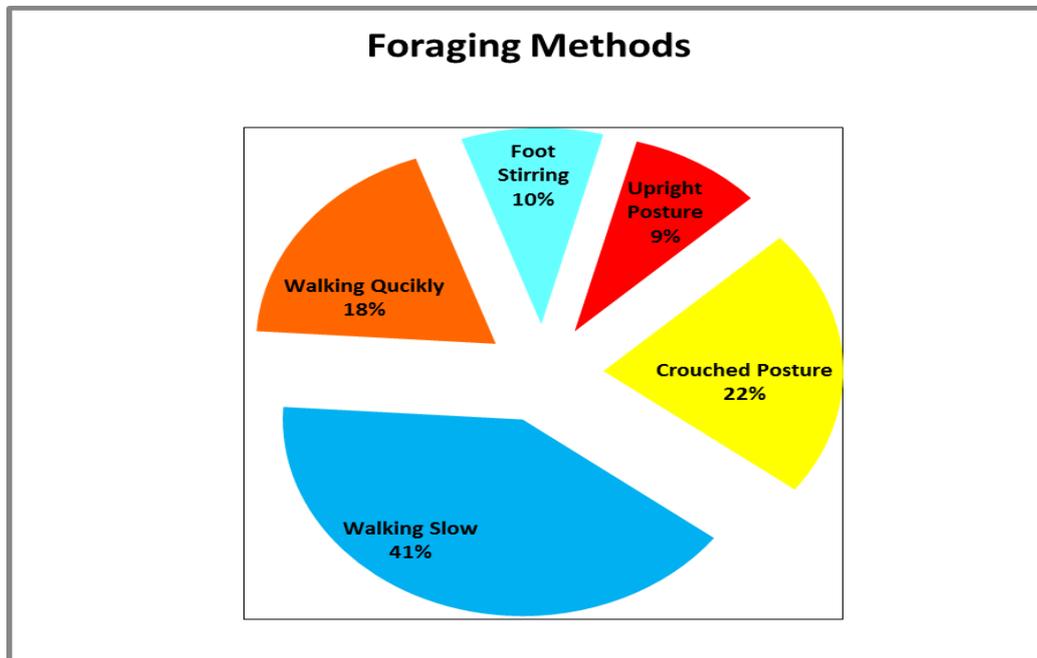
**Table-2: Average foraging attempts per minute by the adults and juveniles in different habitats in Little Egret (*Egretta garzetta*) during foraging.**

S.No	Name of different habitat	Adults			Juveniles		
		Average steps per minute	Average pecks per minute	Average items captured per minute (successful)	Average steps per minute	Average pecks per minute	Average items captured per minute (successful)
1.	Open Agricultural fields	13	07	04	17	09	04
2.	Lentic Habitat	11	09	07	15	11	06
3.	Lotic Habitat	07	06	04	11	07	03
4.	Urban Habitat	17	12	03	23	16	01
MEAN ( $\bar{x}$ )		12	8.5	4.5	16.5	10.7	3.5

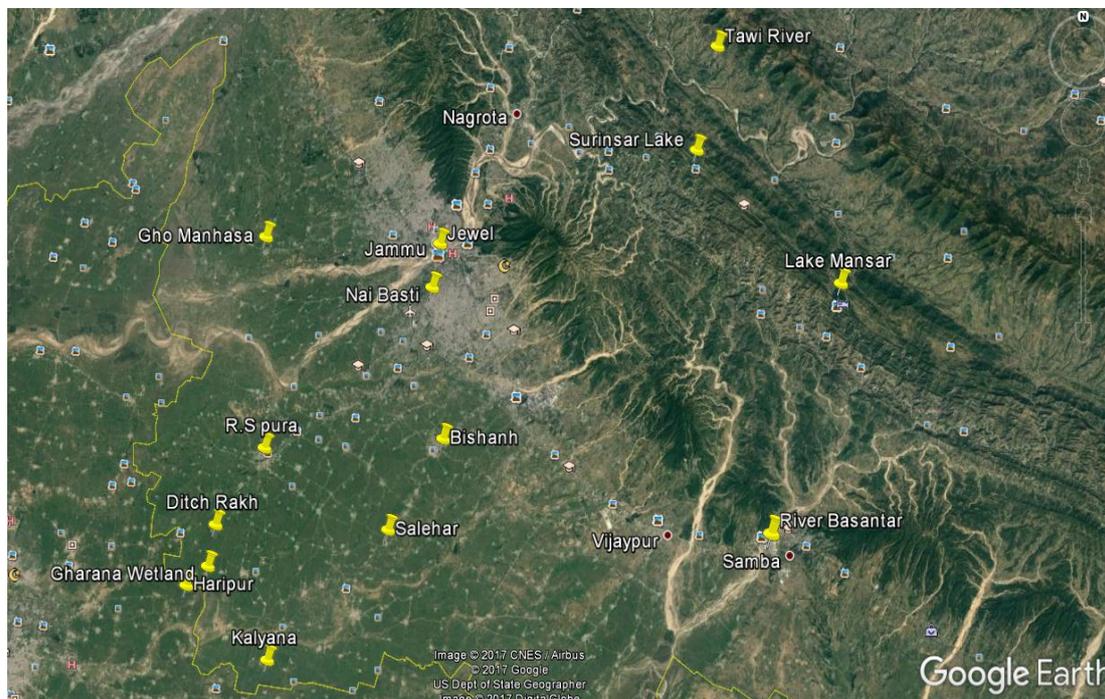
**Table-3: Karl Pearson Correlation between foraging variables of adults and juveniles of Little Egret (*Egretta garzetta*) in different habitats during the study period.**

Type of Habitat	Adults		Juveniles	
	Average steps vs Average pecks	Average pecks vs Successful pecks	Average steps vs Average pecks	Average pecks vs Successful pecks
Open agricultural fields	0.650	0.548	0.429	0.031
Lentic	0.683	0.427	-0.167	0.118
Lotic	-0.548	0.390	-0.319	-0.258
Urban	-0.446	0.098	-0.129	-0.107

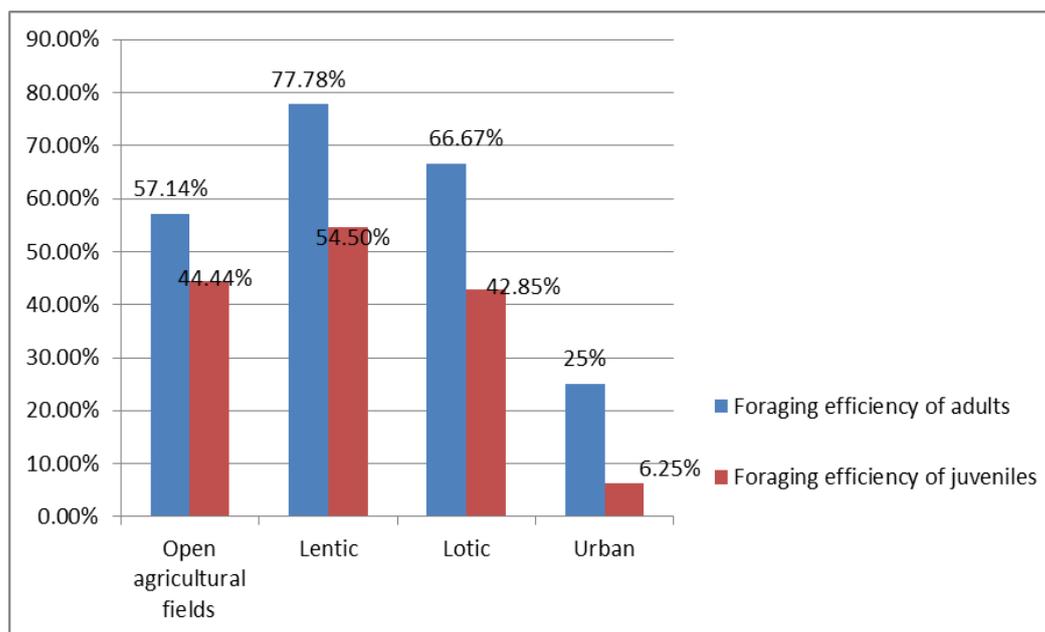
\*Correlation is significant at 0.05 level (2-tailed).



**Fig. 2- Pie chart showing percentage contribution of various foraging methods utilised by Little Egret (*Egretta garzetta*) in the study area.**



**Fig. 1: Map of study area showing 14 study stations.**



**Figure 3: Histogram showing foraging efficiency of adult and juvenile Little Egrets (*Egretta garzetta*) in different habitats.**

### CONCLUSION

Thus, from the present study it can be concluded that Little Egret employs a wide array of foraging tactics in different habitats with Walk Slowly (40.72%) being the most widely used strategy. Adult Little Egrets were found to be more efficient foragers than juveniles and the most preferred foraging habitat was recorded to be lentic habitat with highest foraging efficiency (77.78%) followed by lotic habitat with foraging efficiency (66.67%) and lowest foraging efficiency was noted in urban habitat (25%) in adults (**Figure- 3**).

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