

# Nesting ecology of owl species inhabiting Swat valley, Pakistan

**Shafiq Aziz<sup>1</sup>, Shabir Ahmed<sup>1\*</sup>, Akhtar Rasool<sup>2</sup>, Hina Jabeen<sup>3</sup>, Sardar Azhar Mehmood<sup>1</sup>, Waheed Ali Panhwar<sup>4</sup>, Wali Khan<sup>5</sup>, Muhammad Israr<sup>6</sup>, Muzafar Shah<sup>2</sup>**

<sup>1</sup>Department of Zoology, Hazara University, Mansehra, Khyber Pakhtunkhwa, Pakistan

<sup>2</sup>Centre for Animal Sciences and Fisheries, University of Swat, Khyber Pakhtunkhwa, Pakistan

<sup>3</sup>Department of Microbiology, Women University Mardan, Khyber Pakhtunkhwa, Pakistan

<sup>4</sup>Department of Zoology, Shah Abdul Latif University, Khairpur Mirs, Sindh, Pakistan

<sup>5</sup>Department of Zoology, University of Malakand, Khyber Pakhtunkhwa, Pakistan

<sup>6</sup>Department of Forensic Sciences, University of Swat, Khyber Pakhtunkhwa, Pakistan

**Abstract-** Owls are nocturnal organisms and do not build their own nests so they select nesting sites. Nesting site selection varies among species, usually at the edge of rocky-mountains, with varying floral diversity; dominated by shrubs. In the present study, 31 nests of the four owl species; Eurasian eagle owl, Spotted owlets, Barn owls, and Spotted owl sub-species were recorded from eight localities in Swat valley from January to October 2019. All the nests were located in holes and crevices of the rocky cliffs, rocky canyons, mud cliffs, mountain slope and man-made structures. However, no nest was observed in snags. There was a significant variation in the nested holes and crevices sizes, due to body size variations. Eurasian eagle owls nested in cliffs with a mean height of  $12.99\pm 6.64$ m and nests were located at an average height of  $8.14\pm 5.00$ m. Most of the nesting cliffs were facing the east and southwest. Spotted owlets had an average height of the nested cliffs were  $10.20\pm 3.33$ m with the mean height of  $5.75\pm 2.10$ m and nesting cliffs mostly faced southwest. The nested cliff mean height of the Spotted owl sub-species was  $8.64\pm 0.52$ m and the height of the fort wall was 3.57m. Barn owls nested cliff height was 12.80m, the nest was located 7.92m above the main ground level and cliff-faced the southwest. It was concluded that the owl species were selective in their nesting sites, preferably choosing sites, where food is abundant and easily accessible, having rare chances of predation and frequently facing the sun.

**Index Terms-** Owl, nest site characteristics, nesting habitats, Swat

## I. INTRODUCTION

Many animals have an ability to make structures for their own protection and to raise offspring during reproduction, commonly known as nest, a natural instinct of various animal taxa including; fishes, amphibians, reptiles, birds, mammals, and

insects (Hansell 2005; Collias and Collias 2014). However, nest design varies even within taxa e.g. birds size ranges from small cup shaped constructed by passerine birds to the huge mounds build by mega pods (Hansell 2000). Moreover, nest structure offers perfect anti-predatory defense against natural challenges in the form of predator and natural calamities (Caro 2005). Among animals' birds select nesting sites correspond to environmental features, such as, vegetation, tree, climate, altitude, temperature and flood (Park et al. 2012; Meniaia et al. 2014; Rico and Sandoval 2014). Majority of the birds select and retain nesting sites in their own territory, having highest rate of breeding success based on their breeding experiences of the preceding seasons (Baran and Adkins-Regan 2014). Studying birds' habitat has a significant factor in comprehension of breeding ecology of the species, because nest sites selection is directly associated to the breeding success of the birds (Lee et al. 2010; Park et al. 2012). Owls are the nocturnal predators and very poor nest builders, usually hides during day time in dark places, in holes or in thick foliage, and this advantage was mainly coming to these birds by their highly protective plumage coloration (Higgins 1999; Mikkola 2014). Many species of the owls nested in hollows of old trees and the removal of hollow-bearing trees have direct effect on them. Other preferable nesting sites include; abandoned buildings and caves (Higgins 1999). Unfortunately, in Pakistan Owls is one of the poorly studied wildlife animals and

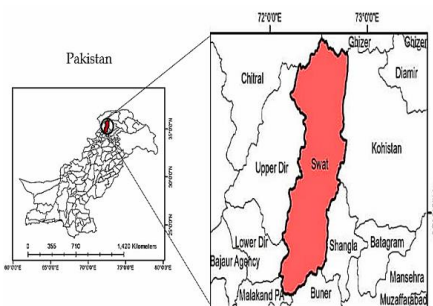
previously, no study has been conducted in Swat valley, Khyber Pakhtunkhwa. As per general observation and assumption populations of these nocturnal birds were in declining mode day to day due to habitat degradation and they need direct human interruption for their conservation in Swat valley. This study was designed to understand the nesting ecology of different owl species in Swat valley, Pakistan. The importance of this study was strongly associated with the preservation and management of these raptors.

## II. RESEARCH ELABORATIONS

### Study area

The study area was an agro-ecological area and temperate zone of Pakistan with rich flora and fauna spreads over 5337 Km<sup>2</sup> of land (Fig. 1), and altitudinal variations range from 600-6000 m comprising of the river and mountainous ranges (Ahmad et al. 2015; PPAF 2015). Phyto-geographically, mostly valley area comes under the Sino-Japanese region with plentiful precipitation in the form of monsoon rains during summer, while the Northern parts (Swat Kohistan) of the valley with slight monsoon rains in summer and heavy snowfall during winter come under the Irano-Turanian region. The only drainage basin of Swat valley is River Swat, which originated from the alpine and flows through subalpine, cold temperate, cool temperate, humid temperate, and then subtropical agro-climatic zone (Ahmad et al. 2015).

Data were recorded from eight different localities (Didawar, Gumbatona, Mahak, Manyar, Nagoha, Nemograhm, Qalaa, and Sahil Abad) in Swat valley from January 2019 to October 2019 based on the presence of owls with an elevation ranges between 779 to 1208 meter from sea level.



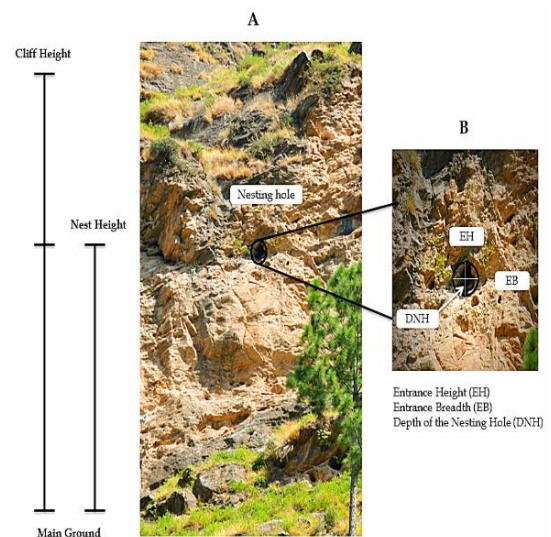
**Fig. 1** Map of Swat valley and its administrative boundaries (ESRI 2013)

### Criteria for nesting and roosting sites selection

The nesting and roosting sites were selected randomly by considering the following condition randomly. (a) Selection of mountains; the mountains with the best suitable nesting and roosting sites have more rocky cliffs and canyons. (b) The playback technique was used in which recorded calls of the owl species play back and waited for their responses. This technique was more helpful during the early evening and morning. (c) The information from local people about the location of the owl's nesting ground.

### Characterization of nests and nest-sites

Different nest parameters, such as nest type, size of the nest; entrance height, entrance breadth, and depth were measured by using a measuring tape (Mahmood et al. 2018). Similarly, nest site characteristics were studied by measuring the height of the nested cliff from the main ground level, nest height, and nest site direction and elevation. (Papageorgious et al., 1993) (Fig. 2). GPS readings were recorded for selected nesting sites by using Google earth. A compass was used to determine the direction of the nest sites and cliffs.



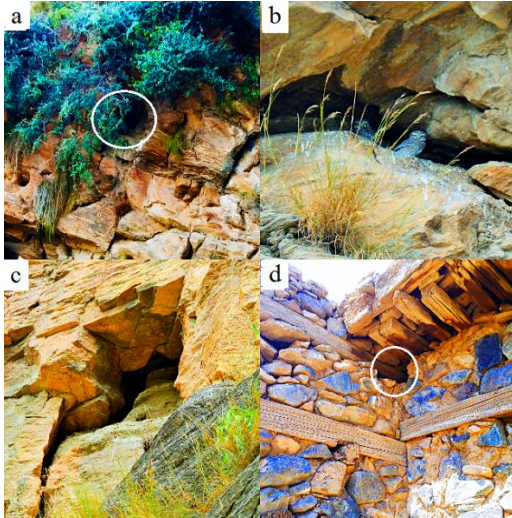
**Fig. 2** Field photograph showing owl's nest on a cliff a, height of the nesting cliff, nest height and b, nesting holes characteristics such as entrance height, breadth and depth of the nesting structure

## III. RESULTS

### Observed nests

Owls did not build their own nests but used holes and crevices of rocky cliffs, canyons, mud cliffs, mountain slope, and man-made

structures. No nest was observed in trees due to the lack of old and thick forests in the study area. A total of 31 nests of these raptors were recorded; Eurasian eagle owls (n=10), Spotted owlets (n=16) Barn owls (n=1), and Spotted owl subspecies (n=4) from eight different locations (Fig. 3).



**Fig. 3** Represent nests of different owl species: a, nest of the Eurasian eagle owl b, Spotted owl c, Barn owl and d, Spotted owl subspecies in Swat valley

**Nest characteristics**

Majority of Eurasian eagle owl's (*Bubo bubo*) nests were found in naturally occurring holes (80%). However, the remaining (20%) of the nests were observed in crevices of the cliffs and canyons of rocky-mountains. The nests were recorded from four different sites in the Swat valley, including; 04 at Gumbatona, 03 at Qalaa, 02 sites at Didawar, and a single nest at Nagoha site. However, only two nesting sites were found active, one each at Gumbatona and Qalaa site. The mean entrance length of the nested holes and crevices was 66.2±24.96cm, the mean entrance breadth was 54.9±18.01cm, and the mean depth was 161.2±90.12cm (Table 1).

**Table 1** Eurasian eagle owls (*Bubo bubo*) nest characteristics and nesting habitats at four different locations of Swat valley

Locations	Nest type	EL (cm)	EB (cm)	ND (cm)
Gumbatona	Hole	75	87	144
	Hole	51	36	103
	Crevice	71	55	91
	Crevice	117	34	180
Qalaa	Hole	69	58	121

	Hole	56	47	161
	Hole	95	65	113
Didawar	Hole	48	70	380
	Hole	45	66	238
Nagoha	Hole	35	31	81

**EL;** Entrance length, **EB;** Entrance breadth, **ND;** Nest depth

Spotted owlets (*Athene brama*) used holes (62.5%) and crevices (37.5%) of the cliffs and slope of rocky-mountains for nesting purposes. A total of 16 nests of Spotted owlets at five different locations in Swat valley were recorded. Among these 16 nests, 07 were found active and the rest of the nests were inactive during their breeding season. Among these nests, 4 each were located at Didawar and Gumbatona, where 02 nests were active at each site. Similarly, from Mahak and Nagoha 03 nests were observed from each location, again 01 nest from each site was active. Lastly, at the Manyar site 02 nests were recorded, where only one was active. The mean entrance lengths, mean breadth, and mean depth of the nesting holes were 31±12.73cm, 35.18±30.94cm, and 109.62±17.60cm respectively (Table 2).

**Table 2** Nest characteristics and nesting habitats of Spotted owlets (*Athene brama*) at five different locations of Swat valley

Locations	Nest type	EL (cm)	EB (cm)	ND (cm)
Didawar	Hole	27	21	106
	Crevice	18	15	117
	Hole	24	26	148
	Crevice	47	74	135
Gumbatona	Hole	18	26	112
	Crevice	38	131	127
	Hole	16	27	110
	Hole	19	13	123
Mahak	Hole	23	19	101
	Hole	21	25	83
	Hole	28	24	92
Manyar	Crevice	31	67	103
	Hole	53	39	115
Nagoha	Hole	36	17	99
	Crevice	43	18	87
	Crevice	54	21	96

**EL;** Entrance length, **EB;** Entrance breadth, **ND;** Nest depth,

A total of 04 nests of Spotted owl subspecies (*Athene brama indica*) were recorded at two different sites: Nemograhm and Sahil Abad in Swat Valley. However, these nests were located in holes in man-made structure and mud cliff between the agricultural lands. Among these nests (03) were observed at Sahil Abid and one at the Nemograhm site, while at each site a single nest was found active during their breeding season. The mean entrance length, mean breadth, and mean depth of the nesting holes were  $34.25 \pm 6.23$ cm,  $39.25 \pm 25.5$ cm, and  $64 \pm 12.56$ cm respectively (Table 3).

**Table 3** Nest characteristics and nesting habitats of Spotted owl sub-species (*Athene brama indica*) at two different sites of Swat valley

Locations	Nest type	EL (cm)	EB (cm)	ND (cm)
Nemograhm	Hole	26	22	57
Sahil Abad	Hole	38	77	82
	Hole	40	32	63
	Hole	33	26	54

**EL**; Entrance length, **EB**; Entrance breadth, **ND**; Nest depth

Only a single nest of Barn owls was found in crevice of the rocky cliff of mountain at Manyar site. However, the nest was empty during their breeding season. The entrance length of the nested crevice was 109 cm, with an entrance breadth 31 cm and depth 76 cm respectively.

#### Nest-sites characteristics

Eurasian eagle owls preferred those sites for nesting purposes, were fewer chances of predations, had protection from un-usual climatic conditions, and mostly faced the sun, close to their foraging sites and water resources. In Swat valley, Eagle owls nested in cliffs with a mean height of  $12.99 \pm 6.64$  m, while the nest location's average height was  $8.14 \pm 5.00$ m. The nest's orientation was random for these nocturnal birds and nested at elevation ranges between 854–1353m. The cliffs were facing mostly toward the east followed by the southwest. The mean distance of the nests from the road was  $457.3 \pm 185.74$ m and the mean distance from near water source was  $601.7 \pm 210.46$ m recorded.

Spotted owlets nested in rocky cliffs, mud cliff, and mountain slope. The owlets select nesting cliffs with a mean height of

$10.20 \pm 3.33$ m and nests were located at an average height of  $5.75 \pm 2.10$ m from the main ground level. A single nest was found on a mountain slope, the height of the slope was 53.2m and the nest was located at 15.2 m above the main ground level. The nest's orientation was also random for these small-size raptors and owlets nested at elevation ranges between 857–1267m from sea level. The selected nesting cliffs mostly faced toward the southwest. The mean distance of the nests from the road was  $588.12 \pm 328.44$ m and the mean distance from near water was  $807.75 \pm 399.65$ m.

Spotted owl sub-species nested in holes of the mud cliff at Sahil Abad and in the fort wall at Nemograhm site. The mean height of the cliff was  $8.64 \pm 0.52$ m and the height of the fort wall was 3.57m and nests were located with a mean height of  $5.65 \pm 1.26$  m in the cliff, whereas in the fort wall was 2.97 m above the main ground surface. The nest's orientations were found to vary and nests were located at elevation ranges between 1356–1472m from sea level. The cliff and wall mostly faced toward the south. The mean distance of the nests from the road was  $40.25 \pm 1.89$  m and the mean distance from near water was  $172.5 \pm 47.69$ m.

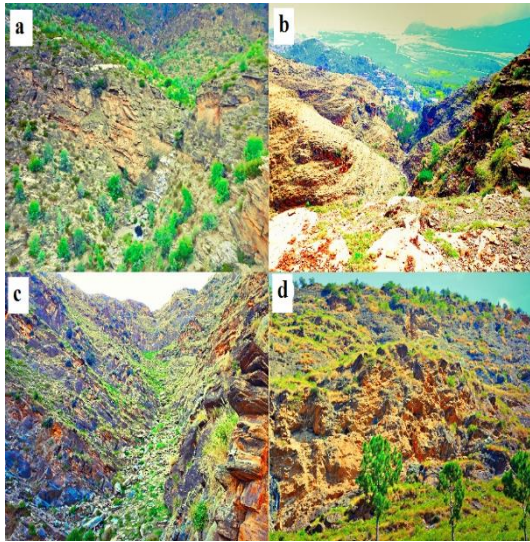
The Barn owl was nested in crevice of the cliff with a height of the nested cliff was 12.80 m and the nest were located 7.92 m above the ground surface. Barn owls nested at elevation 931m and nested cliff facing toward the southwest. The nest-site direction was recorded at  $247^\circ$  and the nest distance from the road and water was 557m and 964m respectively.

#### Nesting habitats

Eurasian eagle owls were found nested at the edge of rocky-mountains or a little bit higher than the edge, neither too close to the human settlements nor far away from their foraging sites. These nocturnal predators gave preference to the rocky cliffs and canyons instead of tree cavities, mountain slopes, mud cliffs, man-made structures etc. in the study area. The nested sites were surrounded by various plant species, among them most dominant species was Hopbush (*Dodonea viscosa*) in all sites, followed by Eucalyptus, Large thorny shrub (*Monothea buxifolia*), and Little leaf cotoneaster (*Cotoneaster microphyllus*) except in Qalaa site, where scattered trees of the Chir pine (*Pinus roxburghii*) were

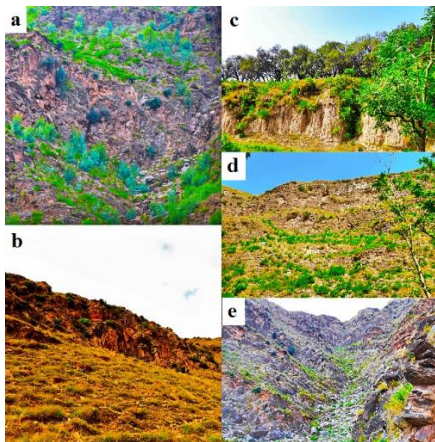


also present in the nesting site of the Eurasian eagle owls (Fig. 4).



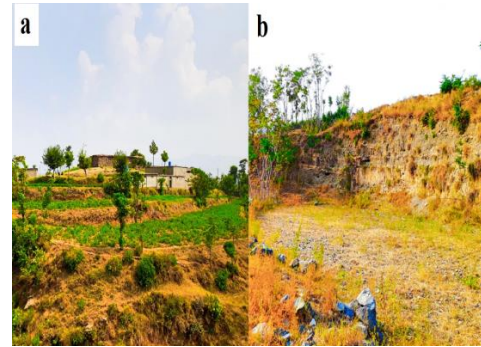
**Fig. 4** Nesting habitats of the Eurasian eagle owls in Swat valley; a. Didawar, b. Gumbatona, c. Nagoha d. Qalaa site

Spotted owl's nests were observed in cultivated land and rocky-mountains. The nesting habitats of the Spotted owlets at four different sites (Didawar, Gumbatona, Manyar, and Nagoha) were almost similar and completely different from the Mahak site. Various plant species were recorded at the nesting sites including; hopbush (*Dodonea viscosa*) was a dominant plant species, followed by Eucalyptus, Indian olive (*Olea ferruginea*), Large thorny shrub (*Monothecha buxifolia*), little leaf cotoneaster (*Cotoneaster microphyllus*), whereas in Mahak site most dominant plant species was Indian olive followed by the tree of heaven (*Alianthus altissima*) and Chinaberry (*Melia azedarach*) respectively (Fig. 5).



**Fig. 5** Spotted owlets nesting habitats in Swat valley; a, Didawar, b, Gumbatona, c, Mahak d, Manyar and e, Nagoha site

The subspecies of Spotted owlets were found to be nested in man-made structure as well as in mud cliff of cultivated lands. The dominant plant species was the Indian olive (*Olea ferruginea*) at the Nemograhm site, whereas in the Sahil Abad site tree of heaven (*Alianthus altissima*) was dominant (Fig. 6).



**Fig. 6** The nesting habitats of the sub-species of Spotted owlets in Swat valley; a, Nemograhm and b, Sahil Abad site

Barn owls were found to be nested at the edge of a mountain closed to the agriculture land. The most dominant plant species was hop bush (*Dodonea viscosa*) followed by large thorny shrub (*Monothecha buxifolia*), Little leaf cotoneaster (*Cotoneaster microphyllus*) at their occupied site (Fig. 7).



**Fig. 7** Nesting habitat of Barn owls Manyar site in Swat valley  
The current findings are the 1<sup>st</sup> ever documented record on nesting ecology of different owl species in Swat valley. Total of 31 nests of these raptors were recorded; Eurasian eagle owls (n=10), Spotted owlets (n=16) Barn owls (n=1) and Spotted owl subspecies (n=4) from eight different locations. All sites provided suitable nesting and roosting sites, having abundance of prey species in their territories and rare chances of predation.

Atuo and O'Connell (2018) suggested that one of the most significant decisions in life history of the birds is to select nesting habitat that reduces chances of predation and increases the foraging success. The observation of this study revealed that the owl species did not build their own nests in study area and instead of making nests used naturally occurring holes and crevices of the rocky cliffs, rocky canyons, mountain slope, mud cliffs and man-made structures. This behavior of owls has been reported by various researchers for different owl species (Marks 1986; Papageorgiou et al. 1993; Steger et al. 1997; LaHaye and Gutierrez 1999; Šotnar 2007; Tumurbat et al. 2009; Whiklo and Duncan 2014; No et al. 2015; Wu et al. 2015). The size of the nesting holes and crevices (length, width and depth) were found significantly different from species to species and even considerably varied in between members of the same species. previous endorse these findings as they suggests that each species has its own choices for the height, position, orientation, accessibility, shelter, and visibility of the nest site and interspecies variations in nest sites selection may be because of variations in flight performance and body size of different species, may also due to the interspecies variations in climatic conditions and nest predation risk during feeding and breeding habits (Tapia et al. 2007; Newton 2010; Janes 1985).

Eurasian eagle owls were nesting in the holes and crevices of cliffs and canyons of the rocky-mountains. Cramp (1985) and König and Weick (2008) documented, that Eagle owls and other larger species of owls nesting in cliffs cavities, rock ledges, nesting on stumps of broken trees and uninhibited nests of other birds, and very rarely in man-made buildings. Mean height of the Eurasian eagle owls nesting cliffs was  $12.99 \pm 6.64$  m, (range: 23.52–6.94 m), an ignored cliffs for nesting having height less than 6 m and greater than 24 m and the nests were located at mean height of  $8.14 \pm 5.00$  m (range: 4.17–14.27 m) above the ground and nests elevations range between 854–1353 m. The selected nesting cliffs were found faced mostly to the East followed by Southwest and West. Mean distance of nests from road was  $457.3 \pm 185.74$  m (range: 264–738 m) and mean distance from water was  $601.7 \pm 210.46$  m (range: 441–1080 m), not similar result with a study conducted in Greece (Papageorgiou et al. 1993). Spotted owlets nested in holes and crevices of the rocky cliffs, mud cliff and mountain slope and previous studies describe that Spotted owlet nesting in cliffs (Robert 1991), also used tree cavities, holes and cracks in buildings walls (Mahmood-ul-Hassan et al. 2007), and mostly connected with human habitation and agricultural area, where they predominantly feed on rodents and insects (Ali and Santhanakrishnan 2015). Barn owls nested in crevice of the

rocky cliff and study reveal that nests of the Barn owls located in trees holes, cliff crevices and ledges, burrows in river banks, caves and in many different types of man-made structures (Marti et al. 2005).

#### IV. CONCLUSION

On the basis of our findings, it may be concluded that owl species did not build their own nests and instead of making nests used holes and crevices of rocky cliffs, rocky canyons, mountain slope, mud cliffs, and man-made structure. No nest was observed in trees due to the lack of old forests in the study area. The sizes of the nesting structures found significantly varied from species to species and were even considerably different due to interspecies variations in size. Each species has its own choice of nesting site selection, but mostly nested in cliffs facing the sun and not far away from their foraging sites. The selected nesting sites were characterized by various plant species and frequently dominated by shrubs (*Dodonea viscosa*) followed by Eucalyptus and Indian olive (*Olea ferruginea*).

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## AUTHORS

Shafiq Aziz, MPhil, Hazara University Mansehra,

[shafiq.orn@gmail.com](mailto:shafiq.orn@gmail.com)

Shabir Ahmed, PhD, Hazara University Mansehra,

[shabirsaki@gmail.com](mailto:shabirsaki@gmail.com)

Akhtar Rasool, PhD, University of Swat,

[arasool@uswat.edu.pk](mailto:arasool@uswat.edu.pk)

Hina Jabeen, PhD Women University Mardan,

[microbiology@wumardan.edu.pk](mailto:microbiology@wumardan.edu.pk)

Sardar Azhar Mehmood, PhD, Hazara University

[banianhu@gmail.com](mailto:banianhu@gmail.com)

Waheed Ali Panhwar, PhD, Shah Abdul Latif University

[waheedalipanhwar11@gmail.com](mailto:waheedalipanhwar11@gmail.com)

Wali Khan, PhD, University of Malakand,

[walikhan.pk@gmail.com](mailto:walikhan.pk@gmail.com)

Muhammad Israr, PhD, University of Swat,

[israr@uswat.edu.pk](mailto:israr@uswat.edu.pk)

Muzafar Shah, PhD, University of Swat,

[muzafarshah39@gmail.com](mailto:muzafarshah39@gmail.com)

**Correspondence Author** – Shabir Ahmed,

[shabirsaki@gmail.com](mailto:shabirsaki@gmail.com), +92-3335330272