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Characters of nesting site, ground nest and eggs of Yellow-wattled Lapwing *Vanellus malabaricus* (Aves: Charadridae)

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Abstract
Yellow-wattled lapwing *Vanellus malabaricus* is one of the rare lapwing species distributed in India. The ground nest is a saucer shaped. In the outskirts of Nanded City 02 Nest/15 km^2, 03 eggs/nest and 01 nest/nesting site were found. Each nest was made from central excavated cup, outer shallow slope and outer rim of soil with gravels and dried pieces of cow dung, straws, plant branches and grass. Nest microstructure was explained first time. The nest and eggs ware perfectly camouflaged with soil texture and colour. It is first report of nest microstructure of *Vanellus malabaricus*. Stray dogs, grazing cattle and human being were common agents identified to destruct the nests and eggs. It is need to categorize this lapwing in to Near Threaten (NT) instead of current status as Least concern (LC).

Keywords: *Vanellus malabaricus***,** Lapwing, Bird nests, eggs

1. Introduction
Vanellus malabaricus (Linnaeus, 1758) is commonly known as Yellow-Wattled Lapwing (YWL) (Mankadan and Pittie, 2004) [15] classified under Order: Charadriformes, Family: Chradriidae (Weirsma and Kirwan, 2016; Avibase, 2016) [20, 2]. There are 25 known species of lapwings in the world of which 18 species found in Indian subcontinent. Sporadic and rare occurrence of Yellow-wattled Lapwing (YWL) has been reported from few states of India. At Kurukshetra (Haryana) the presence of this wader is reported (Gupta and Kaushik, 2012) [9]. The nest, eggs, hatching and fledging success of YWL was described by Sethi *et al*., (2010) [19] at Haridwar (Uttarakhand, India). Its occurrence is also reported from the outskirts of Delhi; near Jamnagar in Gujrat; similarly in parts of Tamil Nadu and Karnataka (Jaykar and Spurway, 1965, 1968; Dhindsa, 1983; Sethi, *et al*. 2010; Gupta and Kaushik, 2010; Islam and Rahmani, 2004) [12, 7, 18, 9, 11]. Whereas there are many reports but limited only to enlisting the occurrence of this lapwing under the checklist of birds from various regions of Maharashtra (Kulkarni *et al*., 2005; Chavan *et al*, 2015) [13, 6]. Detailed report on nest and egg characteristics especially from Maharashtra and selected area were not found. Till year 2016 the YWL has been categorized as least concern (LC) by IUCN but now a day's its occurrence was mostly reported as rare bird as compared with other birds and especially common lapwing species Red-wattled Lapwing (RWL) *Vanellus indicus* of this region. Recently YWL has attracted our attention during avifaunal survey from Godavari river basin (Chavan *et al*., 2015) [6] due to its rare occurrence. The need of *V. malabaricus* for nesting place and nesting material are specific. The threat factors responsible to destroy the nest and eggs of this shy and kind bird will be a great concern to launch a special program on conservation of this bird at Odumbe in Karnataka State of India indicating the importance of conservation of this wader. Kumar and Kanaujia (2015) [14] reported unusual sighting of YWL at Lucknow, India in the form of a flock of 25-35 near a college building, but this might be really an unusual scene because at various reported habitats and locations its presence is reported as 1-2 pairs only. To produce the baseline data and comparative variation on nesting and breeding ecology with Red-wattled Lapwing (RWL) this investigation was undertaken and first time it is being reported with photographic evidences on microstructure of nest (Fig. 14) and eggs of *Vanellus malabaricus*.

2. Materials and Methods
A) Survey and study area
During avifaunal survey in Godavari river basin in Nanded and Parbhani districts of Maharashtra State in year 2014 and 2015 the YWL (*Vanellus malabaricus*) was found as a rare bird (Chavan *et al*, 2015). Manly it was encountered as a suddenly flying bird with sharp cuts and flights of short distance and low heights by producing a typical noise 'Ptchee-it'. In 20 km^2 area after rigorous search we could find only 3-4 pairs. It was found that during all seasons in the outskirts of Nanded city in the vicinity of CIDCO Nanded. Three pairs of *V. Malabaricus* were found nested on the ground. Total three nests were constructed on the ground. The area selected for nesting was a scrub waste land mainly non-productive for agriculture was left for grazing the cattle by the land owner since last sixteen years. The area was used as used as pasture to graze the cattle during monsoon season (June-September) and early winter season (October-December). The land was having slight slope for fast seepage of rain water. Total area of waste land was ten acres which remain unused for cultivation but surrounding land was in use for agriculture purpose for one crop rotation/year. The crop in the surrounding area of nest land was Soyabean, Jowar, Cotton, Peanuts, Kajanus kajan etc. Out of three nests two were at one locality i.e. 500-600 ft distance from a tar road with continuous traffic of vehicles from CIDCO area to village Kiwla and another single nest was located about 1 km. distance east to Gramin Polytechnic, Nanded in the area behind Guru Govind Singhji College of Engineering Nanded. Two locations of the nesting sites were about 5 km away from each other. The coordinates of the nesting area are 19^0 2$^{'}$ 39" N and 77^0 18$^{'}$ 17"E.

B) Survey Method and equipment's used

For the observations on site selection for nesting and nest construction process a binocular was used. NIKON Cool pix digital camera – D 510 (16 Pixel and 42 X auto zoom lenses) was used for photo and Video recording. Digital Varner Calliper (Least Count 1 mm) was used to measure the length and diameter of eggs. Battery operated Digital weighing balance (least Count 10 mg) of pocket size was used for weighing the eggs and nesting material of YWL at the nesting site. Care was taken not to disturb the position of laid eggs and nesting material. Rolling spring metal strip scale was also used for the measurement of nest and surrounding area.

The data on nests, eggs was compared and mean values are noted. Two days/week the nesting site and nest were visited from the month of April to July 2016 and various details are recorded about the nest, eggs and selected area for nesting. All the standard protocols for birding and bird studies were followed (Bibby *et al*., 2000; Grimett *et al*., 2011) [8, 3].

3. Results and Discussion

A) Selection of nesting area by Yellow-wattle Lapwing (YWL)

Vanellus malabaricus was found to prefer unused plane and waste land with rarely spread short shrubs of thorny plants mainly *Acasia nilotica* to construct ground nest for egg laying. Remarkably the nesting area was neither far away nor close to residential area. Sharma and Sharma (2016) [17] reported that the male select nesting site and call the female during summer season the temperature of the area was 40-44 ^{0}C while in winter it was in the range of 8-20 ^{0}C. The annual rainfall of south-west monsoon in the area was average 350-900 ml. From June to October months of a year. In monsoon season the area converts in to a grazing land covered with grass of 5-10 cm height, the land is used as a pasture by the land owner for cattle grazing. Since year 2000-2016 the land was used as pasture by the owner for cattle grazing. Birds like swallows select most safe place for colonial nest (Chavan *et al*., 2016) [5]. Similarly the safety patterns maintained by Baya weaver (*Ploceus phillipinus*) for nesting and nest site selection is reported (Achegawe *et al*, 2016) [1] in Godavari river basin but in case of YWL the nest site selection was found most unprotected and on the mercy of human being and its activities.

B) Nest Characters

Nest construction and structure

Vanellus malbaricus construct a peculiar ground nest which get perfectly camouflaged with the surrounding land colour and texture till the hatching success. It is very difficult to locate the nest of this lapwing, it needs careful observation on the ground by slow walking. During the nesting period the chance of getting the nest is high in the area where the YWL frequently found on the ground. Care was taken to prevent the eggs in the nest to get tumbled during search. The nest has an excavated shallow depression at the centre ¾ area filled with small to medium sized granular gravels of calcium carbonate which are available locally in plenty. Same kind of gravels were spread on the peripheral rim area of the central depression to give it a saucer shape and finally outermost margin of nest was having a small to medium rim of gravels. Total diameter of the nest was 156-157 mm. Nest construction starts in month of May and completed in June 2016. The central depression was prepared by excavating the soil using toes and gravel were carried in beak one by one and placed in the nest. Usually central area of a scrub land was used to construct the nest. Randomly spread and partially mixed dry straw of grass and dried pieces of tree branches, there were small to medium dry pieces of cow-dung also randomly spread especially in the rim area of the nest but the nest was without accumulated water inside. Probably the dried pieces of cow-dung might be useful to maintain the humidity in the microclimate of nest proper by soaking the rain water. There was medium to heavy rain for 2-3 days during incubation period of eggs in nest. It was difficult to distinguish the male from female of this lapwing species but both the parents construct the nest and involved in incubation of laid eggs in the nest. The details are given in Table 1. Sethi *et al*. (2010, 2011) [18, 19] reported the nest structure of YWL to few characters but the present report is the first to explain the nest microstructure of this species.

Microstructure of Nest

The nest microstructure of *Vanellus malbaricus* shows that it is formed from three main parts 1. Nest cup at the centre, 2. Slope around the nest cup and 3. Rim of nest. There may or may not be hide object like stone or rock piece on the outer side of nest rim (Fig. 8, 10). The nest cup is central part of nest proper which is constructed by excavating the plane land of selected site for the nesting. It was found that, Probably male of YWL excavate the land using its both the feet to prepare a rounded, shallow cup like structure (IJ) (fig. 14). The process of land excavation starts in the first week of month of May and ends within 4-5 days. Around the nest cup there was outer peripheral sloppy area (OM). The last circle of nest is nest rim. The nest cup is filled with mixture of small and medium sized gravel that makes it aerated porous base, on this area the eggs are laid. Single layer of small to medium sized gravel and grass straws are filled in the slopy area which may be called as total width of nest cup (KM). The rim part of nest is formed from mixture of soil, gravels, straws and dried pieces of cow dung. The height of rim (EF) reach to middle of height of YWL when it was in incubation sitting posture. In the outermost plane area of the nest rim there were randomly spread pieces of cow dung and dried plant sticks and pieces of cow-dung. The details of different measurements of various parts of nest of YWL in cross section are shown in Fig. 14. and Table 2. Mainwaring *et al*. (2014) reviewed the nesting in ground birds in arid environment and found that they select cooler area for nesting prevent overheating in warmer environment.

The nest construction completed at the middle of month of June then the eggs are laid. There was no accumulation of rain water in the nest cup or around the nest. It was clear that the YWL wait till lowering the environmental temperature to 20-30 ^{0}C which was result due to onset of monsoon rain then lay the eggs.

a. **Nest Material:** Small to medium size granular gravels of calcium carbonate mixed stone were the major component of nest. Pieces of dry grass and straws of average length 4.0-4.3 cm were used to spread in the entire nest. Total plant material used in the nest construction was 5-6 % compared to gravels and cow dung. Dried pieces of cow dung of small to medium in size having weight 1.0 -10 gm were also used in the nest construction. The details are given in Table 1.
b. **Threats to the nest:** Except camouflaged nature of nest design and the materials used to construct the nest by *Vanellus malbaricus*, it was most unprotected in terms of its place of construction because it is ground nest. Due to

urbanization and increasing population, interfere of domestic animals, stray dogs and human beings in the unused land for various purpose was found increasing. These are few identified threats for the nest and laid eggs of *Vanellus malabaricus.* Out of three nests located at three different places in two localities of the study area only one nest was found successful showing 100% incubation of eggs and fledging success 33.3% which was nearly similar with results from Haridwar, India (Sethi *et al*., 2010) [19]. Foot prints of stray dog were observed near one of the nest (Fig. 11) from where the eggs were missing which were close to hatching period, in this circumstances it was guessed that the stray dog might have predated on the eggs. In another nest the eggs were missing after 1/3 of initial incubation period due to unknown predator or a threat agent. It was also found that the shepherds also consume or sale the eggs of lapwings (Yellow-wattled Lapwing or Red-wattled Lapwing) to those people especially to truck drivers or Taxi Cab drivers to prevent the sleep to facilitate long drive during night. Tumbling of eggs and nest destruction by the grazing cattle was another potential threat for the nesting success of *Vanellus malabaricus.* There was no opposing reaction from the either parent lapwings when any of the threat factors approach the nest. When we approached the nest with eggs under incubation the parent bird fly away and stayed at 50-60 meter distance from the nest without creating any alarming noise. It show some disguising behaviour to the predator by diverting the attention of predator or the threat factor by displaying false quarrel between two parent birds.

Table 1: Measures of different parts of a nest of *Vanellus malabaricus* (Ref. Fig. 5, 6, 10, 14).

S. No.	Particulars of nest part	Abbreviations used (Ref. Fig. 1.)	Scale of measurement
1.	Total width of nest	CR	22.0 cm
2.	Circumference of nest	AB	66.5 cm
3.	Height of rim	FE	5.0 cm
4.	Width of outer area of rim	BR	9.0 – 10.0 cm
5.	Maximum width of rim	MB	7.0 cm
7.	Slope of nest	KL	4.5 -4.7 cm
8.	Minimum depth of nest cup	LI	4.0 -4.3 cm
9.	Maximum depth of nest cup	NH	4.5 – 4.8 cm
10.	Total width of nest cup (excavated area)	KM	12.5 cm
11.	Height of hide (Half buried stone)	PQ	6.0 – 6.2 cm

Table 2: Details of breeding, eggs, incubation and nesting ecology of Yellow- wattled Lapwing *Vanellus malabaricus*

S. No.	Particulars of Breeding	Details and units
1.	Total number of nesting sites identified in 40 km^2 area	Three sites (100 ft. – 5.0 km away from each other).
2.	Nest site selection for nesting and major part of nest construction completed by	Male YWL
3.	Clutch size	3 eggs/nest in one cluster
4.	Egg laying period	Last week of June, 2016 but co-insides with onset of first few rains of monsoon.
5.	Eggs were laid	At the centre of nest
6.	Gender Involvement in incubation of eggs	Both the male and female, but at different time (One parent at a time)
7.	Incubation Posture of YWL	Sit on the eggs by keeping both legs widely apart, eggs covered totally under the abdomen, additional covering of down postured both wings.
8.	Maximum incubation time when no any disturbance	Continuous sitting of 38 minutes.
9.	Eggs exposed between two incubation periods	20 minutes to 1.10 hrs.
10.	Period required for egg hatching (Incubation)	28 days.
11.	Change in position of eggs in the nest during hatching	After every 2-3 days.
12.	Egg shape and colour	Oval, buff creamy streaked with irregular black spots, bands and blotches (Fig. 4, 9)
13.	Average weight of an egg (in clutches of two nests)	11.47 gm and 13.28 gm.
14	Average width of an egg (in clutches of two nests)	2.6 cm. and 2.7 cm.
15.	Average length of an egg (in clutches of two nests)	3.7 cm and 3.7 cm.
16.	Number of successful nests out of three located.	01 successful nest (Nesting success (33.33 %)
17.	Reasons for eggs destruction from two unsuccessful nests.	Due to predation by stray dog (Confirmed from foot marks near nest) after 09 days of incubation. From second nest the eggs disappeared without any traces of predation, may be due to stolen by cow boys, stray dogs or any unknown factor.
18.	Distance of nest from transport tar road.	70-80 meters
19	Distance of nest from path-way.	3-4 meters
20.	Distance of nest from main large tree in the region.	10-120 meters
21.	Distance of nest from near shrub	1.0 – 4.0 meters
22.	Height of nearest shrub	1.0 – 1.2 meters
23.	Environmental temperature during nesting.	30^0C – 40^0 C.
24.	Insect species found in the nest and around the laid eggs.	Black ants

25.	Weight of Short Pieces of dried grass and straws used in the nest	1.5 – 7.3 cm
26.	Weight of Gravels (Containing $CaCo_3$) used in the nest	1.0 - 4.6 gm
27.	Weight of Dried pieces of cow-dung used in the nest used in the nest	1.2 – 3.7 gm
26.	Dried pieces of tree twigs used in the nest	1.7 – 3.2 gm

A) Characters of eggs and incubation process

The eggs of YWL are oval in shape, with little blunt end at one end. The length, width and weight are given in table 1. The eggs are buff-yellowish white in colour with faint and dark black colour patterns of small to medium spots, blotches and irregular dotts. All the colour pattern of the eggs perfectly resembles to the ground conditions where the nest was located and it was the perfect camouflage strategy of *V. Malabaricus.* The clutch size in a nest was 03/nest from the observed two nests. Charan (2015) [4] reported presence of 4 nests on a private land near Khanna, Punjab each was having clutch size 4 eggs/nest. Eggs were laid in the centre of nest on the gravels in the nest cup region. Both the parents were involved in incubation process. The details of incubation process are as in table 2. Stray dogs, wolves, grazing cattle, cow boys, predation by Red-wattled Lapwing (*Vanellus indicus*) were the major active and passive threats observed for the destruction of YWL eggs (Gupta and Kaushik, 2012). There was no unfertilized or non incubated egg found in any nest during the study. After regular monitoring on the incubation process too we could not find the hatched young ones that might had happened during late evening or very early morning but 2-3 pieces of egg shells were found at the successful nest indicating successful hatching of eggs and fledging of young ones because they are 'nidifugous' meaning they leave the nest shortly (within 30-40 min.) after hatching. Post hatching parental care of chicks is new scope of study on this lapwing.

4. Conclusion and recommendation

Vanellus malabaricus breeding, morphometric characters of nest and eggs were investigated first time from the selected study area. Yellow-wattled Lapwing as a ground nesting bird has no effective protection strategy to built the nest for egg laying except camouflage with the ground condition for colour of nest and the eggs. As a ground nest there are several threats for destruction of nest and laid eggs because this species has not any effective strategy for nesting and protection of eggs hence there is at most need to protect the nesting grounds of *V. Malabaricus.* Considerably low population 6 pairs/20 km^2 were found which is alarming signal to rethink on its candidature from current status of *Vanellus malabaricus* as Common bird to include it under Near Threaten (NT) category of IUCN. To launch special conservation and protection program for this species is highly recommended.

Fig 1: *Venellus malabaricus* (Baddard, 1783) (Yellow-wattled Lapwing) located inthe outskirts of Nanded city, M. S.

Fig 2: Unused Agriculture land, scrubland used for nesting and egg laying by *Venellus malabaricus* near Nanded, MS.

Fig 3: Overview of ground nest (Nest No. 1.) of *Vanellus malabaricus*

Fig 4: Length of egg of *Vanellus malabaricus*

Fig 5: Measurement of nest of *Vanellus malabaricus*

Fig 6: Weighing the egg of *Vanellus malabaricus*

Fig 8: *Vanellus malabaricus* Incubation position on eggs in the nest (Nest No. 2.) Date: 03/07/2016.

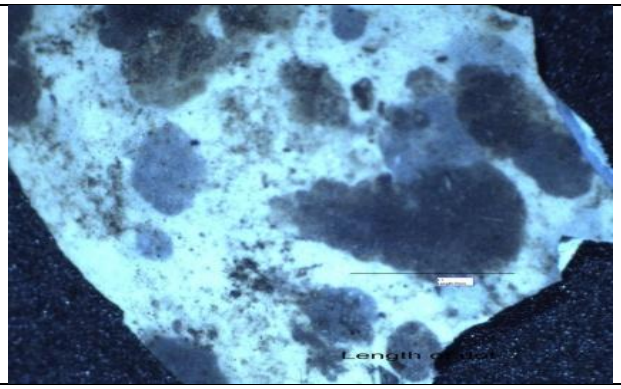

Fig 9: Colour pattern on the egg shell surface of *Vanellus malabaricus*

Fig 10: Nest (No.2) and eggs of *Vanellus malabaricus* (Note the half-burried stone as hide close to nest) Date: 10/07/2016

Fig 11: Empty nest (No.2) of *Vanellus malabaricus* due to predation of eggs by stray dogs (Foot prints at arrow) Date- 15/07/2016

Fig 12: Eggs and Nest (No.1) of *Vanellus malabaricus* (Close to hatching Period- 23/07/2016

Fig 13: Hatched eggs of *Vanellus malabaricus* (Nest No. 1.) (Egg shell break in to 2-3 parts during hatching as successful nest) Date- 27/28-07-2016

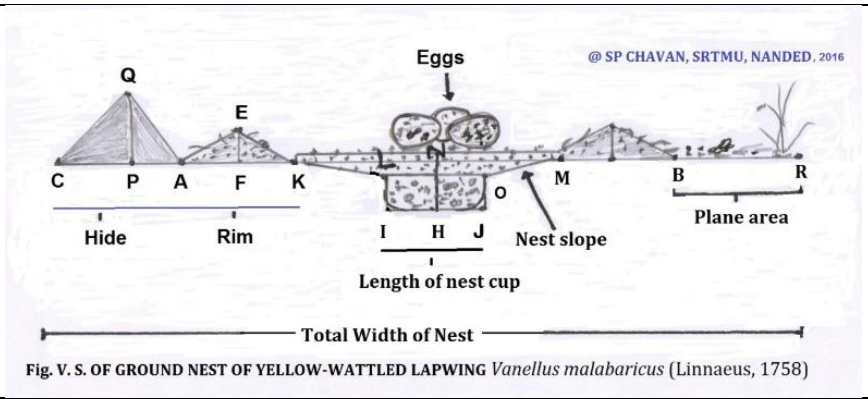

Fig 14: Vertical Section of Nest of Yellow-wattled Lapwing *Vanellus malabaricus*

5. Acknowledgements

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