Precise and accurate behavioural monitoring of captive Chukar (*Alectoris chukar*) by using the advanced digital ethogram: a small scale pilot study

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Studies concerning animal behaviours are of great importance in conservation biology, especially to record the time-activity budgets of wild animals in response to the anthropogenic pressures (Sutherland, 1998). However, animal behaviour studies either in the wild or in captivity; normally depend on man-made observations where there are remarkable probabilities for errors and lack of accuracies (Lendvai et al., 2015). Conventional methods for behaviour observations include; Group scan sampling, Scan sampling, and Focal sampling as described by Altmann (1974). The basic principle of these methods is to follow animals, observing them, and recording the observations on pre-defined check sheets. Most animal behaviours are very elusive and for very short intervals, especially when it comes to birds, and can be easily skipped from the eyes of a human observer (Khattak et al., 2019a). In such cases observing behaviours and recording the duration simultaneously, chances of mistakes and inaccuracies are increased many folds (Kusmarani et al., 2019). Later on, biased data and observations can result in designing poor management and conservation strategies. However, the recent developments in science have made it possible to overcome such limitations greatly (Lendvai et al., 2015).

Due to human activities, the wild natural habitats are greatly degraded and shrank, due to which many species are raised in captivity with the aim of re-introduction (Williams and Hoffman, 2009; Khattak et al., 2020). In captive breeding animals, there is a strong possibility for exhibiting altered behaviours (Bereton and Rose, 2019). Behaviour studies in captive animals are thus very important, particularly in those animals which are raised for re-introduction purposes. Results from such studies also give a complete insight into animal welfare (Khattak et al., 2019a). In Pakistan several wild species including mammals and birds, in particular, are raised in captivity; however, there is a lack of behavioural studies in these captive animals predominantly for birds. Chukar partridge (*Alectoris chukar*) is the national bird of Pakistan. In Pakistan the populations of chukar partridge seem unaffected so far, however threats like increased human encroachments into the wild habitats and poaching can potentially compromise the stability of this species. In the current study, for the very first in Pakistan, we tested the digital ethogram for studying the behaviour of captive breeding chukar partridge. The study aimed to introduce the modernized methods and digital tools for animal behaviour studies in Pakistan.

The current study was conducted at the newly established breeding center for partridges at Manglot wildlife Park Nizampur (33°45'19"N;72°0'15"E) Nowshera district of Khyber Pakhtunkhwa Province (KPK), Pakistan. Chukar partridge is distributed from lower to higher (520-1534m; above sea level (asl) elevations in Nizampur and nearby areas of Cherat (Khattak et al., 2019b). In the current study, we selected a single adult-male chukar partridge. The subject animal was named “Rocky” for subsequent procedures. Following (Carmi-Winkler et al., 1987; Rantanen et al., 2010), we designed an ethogram for the chukar partridge (Table 1).

For designing the whole project, BORIS version (7.9.21) developed by (Friard and Gamba, 2016) was used. Both the BORIS desktop and android versions (Mobile phone) were installed in Haier laptop (Microsoft windows-10; 64-bit operating system) and Redmi Note-5 mobile phone (MIUI 11 Android 9.0 operating system) respectively. The whole project was designed on the BORIS desktop and was transferred to BORIS mobile for data collection. The observations in the current study were based on focal animal sampling. The study was conducted on 19th November 2020 from 8:00 am-9.00 am. The duration of each event was recorded with an accuracy of 0.001 seconds. All behaviours that occurred were recorded in real-time by tapping the respective buttons of the ethogram displayed on the mobile phone. All the observations recorded were later analysed in BORIS desktop v.7.9.21 using a built-in analysis tool for activity budgets and events plotting (Figure 1).

In the current pilot study, a dataset for 3600 seconds was obtained. A total of 532 events (START and STOP) happened, yielding 266 observation points. Out of the total 13 behaviours enlisted in the ethogram, the focal animal...
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of the bird for maintaining a balance between threat detection and resource acquisition. Since all the events were recorded back-to-back which showed that, the ratio of pecking while sitting was a bit higher than pecking while walking. Such behaviours are the peculiarity of game birds to minimize the detection by predators and utilize resources simultaneously (Grubb Junior and Thomas, 2006). We believe that the average duration recorded for a single call (5.920s) in the current is much more precise as compared to the results reported by (Stokes, 1961). However, some limitations were observed while using BORIS app on a mobile phone, like there was no option for rewinding events or to include ad libitum observations. The current version of the BORIS seems more promising for focal animal sampling. For observations on many animals the groups and categories must be included in the very first ethogram; however, in doing so, it remains impossible to record the individual differences among subjects of the same group. The same problem was also reported by displayed 11 behaviours throughout the study duration. The highest frequencies were recorded for pecking (54), followed by alert (54), walking (45), sitting (28), and so on (Table 2). The spread of events plot showed that during the first 15-minutes of the observation; Rocky displayed a higher and continuous exhibition of walking and running; coupled with alert and vocalization (Figure 2). We assumed that the higher occurrences of these behaviours can be attributed to the approach and presence of the observer near the cage. According to (Hutto and Hutto, 2020) the birds behaviours are abruptly changed in response to the observer approach or presence. Such continuous and long panic behaviours are anti-predator behaviours and a response to the stress and fear caused by a perceived threat (Boissy, 1995; Zaccaroni et al., 2013).

The event plot further revealed that after the first 15 minutes of observation, Rocky displayed a balance between walking and alert coupled with higher pecking. These results showed an excellent and quick adaption of the bird for maintaining a balance between threat detection and resource acquisition. Since all the events were recorded back-to-back which showed that, the ratio of pecking while sitting was a bit higher than pecking while walking. Such behaviours are the peculiarity of game birds to minimize the detection by predators and utilize resources simultaneously (Grubb Junior and Thomas, 2006). We believe that the average duration recorded for a single call (5.920s) in the current is much more precise as compared to the results reported by (Stokes, 1961). However, some limitations were observed while using BORIS app on a mobile phone, like there was no option for rewinding events or to include ad libitum observations. The current version of the BORIS seems more promising for focal animal sampling. For observations on many animals the groups and categories must be included in the very first ethogram; however, in doing so, it remains impossible to record the individual differences among subjects of the same group. The same problem was also reported by

| Behavioral category | Behavior code | Description |
|---------------------|--------------|-------------|
| Threat Detection    | Alert        | Rocky is standing upright with neck out-stretched and scanning the surroundings |
|                     | Sitting      | Rocky is sitting with the head above the level of the back and scanning area |
| Resting             | Inactive     | Rocky is sitting with the head on the same level or just below the level of the back with eyes open |
|                     | Sleeping     | Rocky is sitting with the head on the same level or just below the level of the back with eyes closed |
| Foraging            | Pecking      | Rocky stretched towards ground and Pecking in search of food either sitting or walking |
|                     | Eating       | Rocky is consuming food (grains or vegetation), grains in feeder |
|                     | Drinking     | Rocky is drinking water from Source |
| Maintenance         | Preening     | Rocky is moving beak through feathers |
|                     | Dust baths   | Rocky is rolling in the dust and soil |
|                     | Stretching   | Rocky slowly extends one wing and one leg on the same side of the body |
| Locomotion          | Walking      | Rocky is walking and changing its location |
|                     | Running      | Rocky makes fast runs |
| Social behaviours   | Vocalization | Rocky makes its particular calls |

**Table 1. Ethogram designed and used for the behaviour observation of Chukar (Alectoris chukar).**

![Figure 1. BORIS ethogram display: (A) BORIS desktop version 2.9.2 (B) BORIS ethogram used in mobile phone for recording observations.](image)
Behavioural monitoring of Captive Chukar (Alectoris chukar) from their study conducted on the behaviour of Sumatran tigers (Panthera tigris sondaica) in Indonesia. The current study is a baseline behaviour study on any species from Pakistan, by using the recent and highly advanced technology of digital ethograms. By using and applying this digital ethogram we learned that it reduces the amount of things, which the researcher needs to record simultaneously. Efforts required in live observation; like keeping and using manual procedures and gadgets including check sheets and stop watch timers are not required. The number of total events, behaviour types, and the duration of each behavior were precisely recorded with an accuracy rate of 0.001 seconds. Results from the current study revealed that using this digital ethogram provides an opportunity of smooth transition between recording consecutive behaviours; with accurate timings and thus minimizing the chances of errors to large extent in calculating activity budgets. The data obtained in the current study and analysed through BORIS desktop built-in analysis tool is presented in a much easy and understandable format for readers. Certain limitations are present in the BORIS, however, keeping in view its advantages in terms of time-saving and very precise results we strongly recommend BORIS for behavioural studies of wild animals both in wild and in captivity.

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Table 2. Activity budgets of chukar partridge (Alectoris chukar); performed in BORIS built-in analysis tool.

| Subject | Behaviour     | Total number of occurrences | Total duration (s) | Duration mean (s) | Duration std dev | inter-event intervals mean (s) | inter-event intervals std dev | % of total length |
|---------|---------------|-----------------------------|--------------------|------------------|-----------------|-------------------------------|-------------------------------|-------------------|
| Rocky   | Alert         | 54                          | 548.354            | 10.155           | 4.754           | 55.243                        | 58.117                        | 15.300            |
| Rocky   | Sitting       | 28                          | 390.800            | 13.957           | 9.479           | 93.879                        | 165.865                       | 10.900            |
| Rocky   | Inactive      | 4                           | 143.334            | 35.834           | 11.773          | 137.926                       | 226.840                       | 4.000             |
| Rocky   | Pecking       | 59                          | 936.026            | 15.865           | 10.582          | 31.828                        | 35.871                        | 26.100            |
| Rocky   | Eating        | 19                          | 188.651            | 9.929            | 6.462           | 124.128                       | 161.332                       | 5.300             |
| Rocky   | Preening      | 12                          | 151.952            | 12.663           | 6.592           | 233.719                       | 245.527                       | 4.200             |
| Rocky   | Dust baths    | 8                           | 137.903            | 17.238           | 7.980           | 298.820                       | 348.930                       | 3.800             |
| Rocky   | Stretching    | 6                           | 33.297             | 5.549            | 2.574           | 493.921                       | 445.436                       | 0.900             |
| Rocky   | Walking       | 45                          | 723.757            | 16.083           | 10.392          | 61.205                        | 110.905                       | 20.200            |
| Rocky   | Running       | 11                          | 214.386            | 19.490           | 11.471          | 47.369                        | 33.114                        | 6.000             |
| Rocky   | Vocalization  | 20                          | 118.407            | 5.920            | 1.714           | 147.355                       | 151.411                       | 3.300             |

Figure 2. Spread of time activities for project “Rocky.observations” based on the data acquired on November 19, 2020.
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