Animals exhibit interspecific, intraspecific interactions as well as with the environment. The exploration of their relationship and the process of interaction to their physical environment and to other organisms provided basis for behavioral study. The causes of behavior include both the external stimuli and the internal mechanisms. The functions of behavior include its immediate effects on animals and its adaptive value in helping animals to survive or reproduce successfully in a particular environment. The environments which mainly influence the behaviors of wildlife are habitat quality and climate (Gopal, 1992).

The subtropical monsoonal climate added with the river deposited alluvial plain favors to have different habitat types in the area (Sharma et. al, 2011). The habitat dynamics in the area is shaped and influenced from the annual monsoon flood. Based on the available habitats and its conservation efforts the population and types of available wildlife differs (Sharma and Chalise, 2012). Forests, grassland and wetland are the available habitats in the study area. These habitats not only provided the space but also the good sources of food for them.

Both plantation and naturally regenerated forests are available in the area. The wildlife mainly accumulated in the naturally regenerated forest (Sharma et. al, 2011). The grassland and wetland provided good sources for food and water.

Conservation efforts since 1989 have brought significant ecological changes in the forest system and socio-economic status of the local community. Improved ecological conditions have reflected the occurrence of diverse species of wildlife. The continued eco-tourism with large number of tourist flow inside forest might have affected the behavior of wild animals. These effect need to be quantified and assessed. This study has tried to analyze the behavior of large mammals in the area.

**METHODS**

Observations from fixed places were utilized to observe wildlife behavior. Field studies were conducted on daily basis from 1st April 2010 and completed on 31st March 2011. Five
observers collected focal and *ad lib* data (Altman 1974). The behaviors of studied wildlife were recorded by scan sampling for one minute at interval of 30 minutes. Active and adult individual in group, either male or female, was considered as focal animal (Martin and Bateson, 1993). Interesting behaviors of the group members were recorded whenever they were observed. Observed diurnal behaviors of studied wildlife were recorded on six parameters namely feeding, resting, defense (running or tree climbing up), walking, digging, and playing (Martin and Bateson, 1993, Chalise, 1995):

- **Feeding:** Foraging and feeding activities, eating, chewing, swallowing or not.
- **Resting:** Sleeping and sitting activities, leg relaxed, body touch ground or tree.
- **Defense:** Running/escape or tree climbing up/down activities due to disturbances.
- **Walking:** Moving without eating.
- **Digging:** Digging the land for some purpose.
- **Playing:** Enjoyable activities, body touch or follow, head, leg, body movement.

For simplicity grazing and feeding with movement were categorized as feeding. Similarly, escape behavior, like running of the ungulates and climbing on tree of the rhesus, from disturbances were grouped as defense. Food habits were discerned by direct observation during the scan sampling. Field study was conducted 25 days per month (n = 300 days in one year). Daily observations lasted up to 8 hours. Observation period was divided in three sessions. Morning session started from 6:00 to 10:00 am, afternoon session from 12:00 to 3:00 pm and evening session from 4:00 to 6:00 pm. Among 300 observation 123 events (41%) were conducted in the morning, 84 events (28%) were conducted in day, and 93 events (31%) were conducted in the evening.

**RESULTS**

In one year study period, total direct contact time with the wildlife for behavior study is 310 hours (18,000 minutes). The behavior study is conducted only in day time. During the study, more contact time is for spotted deer (54.7%) and least time for sambar (5.1%) (Fig.16). Barking deer being nocturnal species (Dinerstein, 1980) used 57.4% diurnal time for feeding. During feeding they use 40.8% time for feeding with movement and 59.2% time for grazing. They utilize the remaining time for walking 39.2%, defense (running) 2.9% and resting 0.5% (Fig. 17).
In feeding with movement average feeding schedule is 2 grabs per minute. While in the grazing average feeding schedule is 10 grabs per minute. Food plant species and feeding time devoted on them is *Cynodon dactylon* (33.3%), *Ageratum conyzoides* (16.7%), *Imperata cylindrica* (16.7%), *Digitaria ciliaris* (16.7%) and *Rungia parviflora* (16.6%).

Spotted deer utilize 47.0% of their diurnal time for rest. They are found to spend 42.0% of their time for feeding, 6.0% for walking and 5% for defense (running) (Fig. 18). On the total feeding period they sped 79% time for feeding with movement and 21% time for grazing. During feeding with movement average grabs per minute is 7.7 and that is 14.7 during grazing. They eat ten species of plants. Among those species more frequent species by eat are *Cyanodon dactylon* (29.4%), *Ageratum conyzoides* (20.6%), and *Imperata cylindrica* (20.6%) (Annex 14).
Wild boars are spending more diurnal time (47%) for feeding. During feeding they spend 89% time for feeding with movement and 11% time for grazing. They utilize the other time for defense (running) 17%, walking 11%, resting 19% and digging 6% (Fig. 19).

Behavior observations reveal that rhino spend more diurnal time (75%) for feeding. During feeding they spend 91% time for feeding with movement and 9% time for grazing. They utilize other time for walking (7%) and resting (18%) (Fig. 20). From direct observation of grazing sites in BBZCF, rhino are found to eat seven species of grass. Among them Cynodon dactylon is more frequently eating grass species (27.3%) followed by Callicarpa microphylla (18.2%) and Imperata cylindrica (18.2%) (Annex 14).
Rhesus monkey utilize 42% diurnal time for feeding (Fig. 21). They spend their other time for playing (19%), defense (running and tree climbing up) (18%), resting (15%) and walking (6%). Rhesus is mostly terrestrial and the energy expenditure for climbing trees as supposed to be considered. They are climbing up the tree for special reason either for security or specific clumped food. They are found to spend 7% time for climbing the tree.

Sambar used to spend more diurnal time (55%) for feeding (Fig. 22). During feeding they spend 45% time for grazing and 55% time for feeding with movement. They utilize other diurnal time for resting (35%), walking (7%) and defense (running) (3%).

Figure 20 – Diurnal time budget and different activities for Rhino.

Figure 21 – Diurnal time budget and different activities for Rhesus monkey.
Hog deer use more diurnal time (44%) for walking and 26% diurnal time for feeding (Fig. 23). For feeding they use more time in feeding with movement (93.5%) than grazing (6.5%). They utilize other time for resting (24%) and defense (running) (6%).

Among the studied animal barking deer, rhino, wild boar, rhesus monkey and sambar deer spend more time on feeding. Hog deer are spending more diurnal time on walking and spotted deer are using more time for rest (Fig. 24).


DISCUSSIONS

Barking deer found to spend comparatively more time (57.4%) on feeding on grassland area. They were more relying on the forest grasses. This is due to the presence of different patches of grassland inside the study area, which provided more grazing opportunities than the previous study where dense tree canopy did not allow growing the foraging plant species for this wildlife. Selection of feeding ground and food items vary with the type of habitat. Pokharel and Chalise (2010) indicated that barking deer dependents on field crops in mountain habitat in Nepal.

Parajuli (2007) in his study recorded that spotted deer spent more diurnal time for feeding followed by walking in the similar climatic condition and habitat of Bardia National Park. During this study, spotted deer spent nearly equal time on feeding and resting. However resting time was little prolonged than feeding. This is due to the difference in the study site as well as most of their diurnal time (7 am to 5 pm) of current study site is disturbed from tourism activities, mainly elephant riding. They move away from the cause of disturbances and hide themselves (Mishra, 1982). They were taking rest during the observation time. Instead of consuming wide variety of tree and shrubs as indicated by Dinerstein (1979) in Bardia National Park, spotted deer of BBZCF were mostly consuming forbs and grasses.
species. However the findings of this research resembles with the results of Wegge et. al. (2009), that spotted deer being mixed feeder they used to consume both grass and forbs as their diet in Bardia National Park. This is either due to the availability of diverse grasses and forbs or presence of few palatable tree and shrubs species in this area.

Spotted deer’s 15.2% diurnal time was disturbed due to tourism activities. During the study it was observed that they could easily identify the sites from where they were going to be disturbed. So, during the preparatory phase of disturbance period they left their ongoing normal behavior (like grazing, resting, playing). Before observing the tourists carrying elephants initial 22.7% time period, termed as preparatory phase, was used to identify the areas from where they were going to be disturbed. In this phase they tried to escape and hide from the disturb sites. The behavior observed during the preparatory period were looking around by erecting ears, fawns start running, wakeup from resting, and gathering all group or troop members in close. After these behaviors they tried to move away and hide from the disturbances. If they were unable to hide and happened to be nearby with the touristic elephant, they used to escape faster inside the dense bush patches or into the forest from open ground.

Wild boars are nocturnal (Mishra, 1982) opportunistic omnivores and their diet incorporated at least one energy-rich part, like roots of Asparagus racemosus (Schley and Roper, 2003). Although being nocturnal wildlife they spent day time in different activities. Among them much of diurnal time was observed on feeding in BBZCF. This is either due to disturbance from the tourism activities or less effort needed to search food in the study area.

For rhinoceros current finding resembles with Hutchins and Kreger (2006) in which they found that one-horned rhinoceros used more diurnal time for feeding and the foraging in Chitwan National Park. The food species were grasses (Cynodon dactylon and Imperata cylindrica) and aquatic plants (Hydrilla sp. and Chara sp.). Feeding occurs during the morning and evening. It is an herbivore, grazer, and diet consists entirely of grasses.

Similarly, 71% of the rhino’s diurnal time was disturbed due to the tourism activities. Preparatory phase for the disturbances ended within 5 minutes. During preparatory phase they stop their ongoing normal behaviors (like grazing, milking to calf, walking and feeding with movement). In this time they used to watch towards the disturbing targets. After getting
contact with the touristic elephants they waited for a maximum of 5 minutes and look whether the elephant continuously coming towards them or not. In this waiting phase scaring behaviors like pepping, snoring and running were recorded. After waiting phase, rhino used to escape from the disturbances. During escaping behaviors like hiding in bushes or forests, calling to calf, and standing inside dense bushes were observed.

It was recorded that rhesus monkey spent more diurnal time for resting (Shrestha et. al, 2001). But, in our study they spent less diurnal time for resting. These differences were due to the characteristics of the study sites and time of daily monitoring. Previous study was conducted in between 9 am to 5 pm in the temple area where they rely on pilgrim people and needed less effort for food.

Sambars are nocturnal in nature but being large bodied animals they used to spend more time for feeding. These results were similar with the earlier reports of Mishra (1982), and Hutchins and Kreger (2006). Our finding on the habitat used by sambar was different from the previous studies in Bardia National Park (Dinerstein, 1979a). Dinerstein find the Sal forest was prime habitat for sambar, but they were well distributed in our study area which was sub-tropical Evergreen Riverine Forest (Sharma et. al, 2011). The cause of this different can be the microclimatic condition and less competition with other large deer in this study area for the food. There was competition of sambar with blue bull in riverine area of Bardia National Park (Dinerstein, 1980).

Study about the habit and habitat of Hog deer was conducted in the similar climatic conditions at Chitwan National Park (CNP) and Bardia National Park (BNP) (Dinerstein, 1979a, Mishra, 1982, Dhungel and O’Gara, 1991). Those studies concluded that the Hog deer are solitary wildlife and their favorable habitats were tall floodplain grassland (Dinerstein, 1979a, Mishra, 1982). Similarly, the study regarding their activities in the same areas confirmed that Hog deer tend to be crepuscular in the undisturbed areas, especially during hot and wet season. During this study, Hog deer were mostly observed along the borders of oxbow lakes where the floodplain grasses were short. For the habitat utilization by Hog deer current result resembles with the previous research findings conducted in CNP and BNP that these wildlife favors the grasslands near to wetlands. Only small numbers of this wildlife (Sharma et. al, 2011) preferred the area due to the presence of microclimatic condition resembling floodplain grassland area.
For overall feeding behavior of the large herbivores, current finding resembles with the earlier results (Hutchins and Kreger, 2006) that the feeding time of the wildlife depends on their body size. Although being a nocturnal animal barking deer, sambar, and wild boar (Dinerstein, 1980, Mishra, 1982, Pokharel and Chalise, 2010) used less diurnal time for resting. The impact of the tourism in wildlife behavior were also similar with current findings and Yasuè and Dearden (2006) about the impact of the anthropogenic activities in the natural behavior of bird in Thailand, which indicated anthropogenic activities directly affect the natural behavior of wildlife.