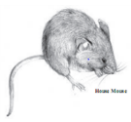
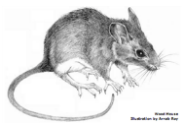


Small Mammal: Rodents and Shrews of Bumdeling Ramsar Site, Trashi Yangtse- Bhutan

1. *Rattus* sp.

2. *Rattus rattus* Linnaeus, 1758

3. *Mus musculus* Linnaeus, 1758

4. *Apodemus sylvaticus* Linnaeus, 1758

5. *Apodemus pallipes* Barrett-Hamilton, 1900

6. *Millardia meltada* Gray, 1837

7. *Tatera indica* Hardwicke, 1807

8. *Soriculus nigrescens* Gray, 1842

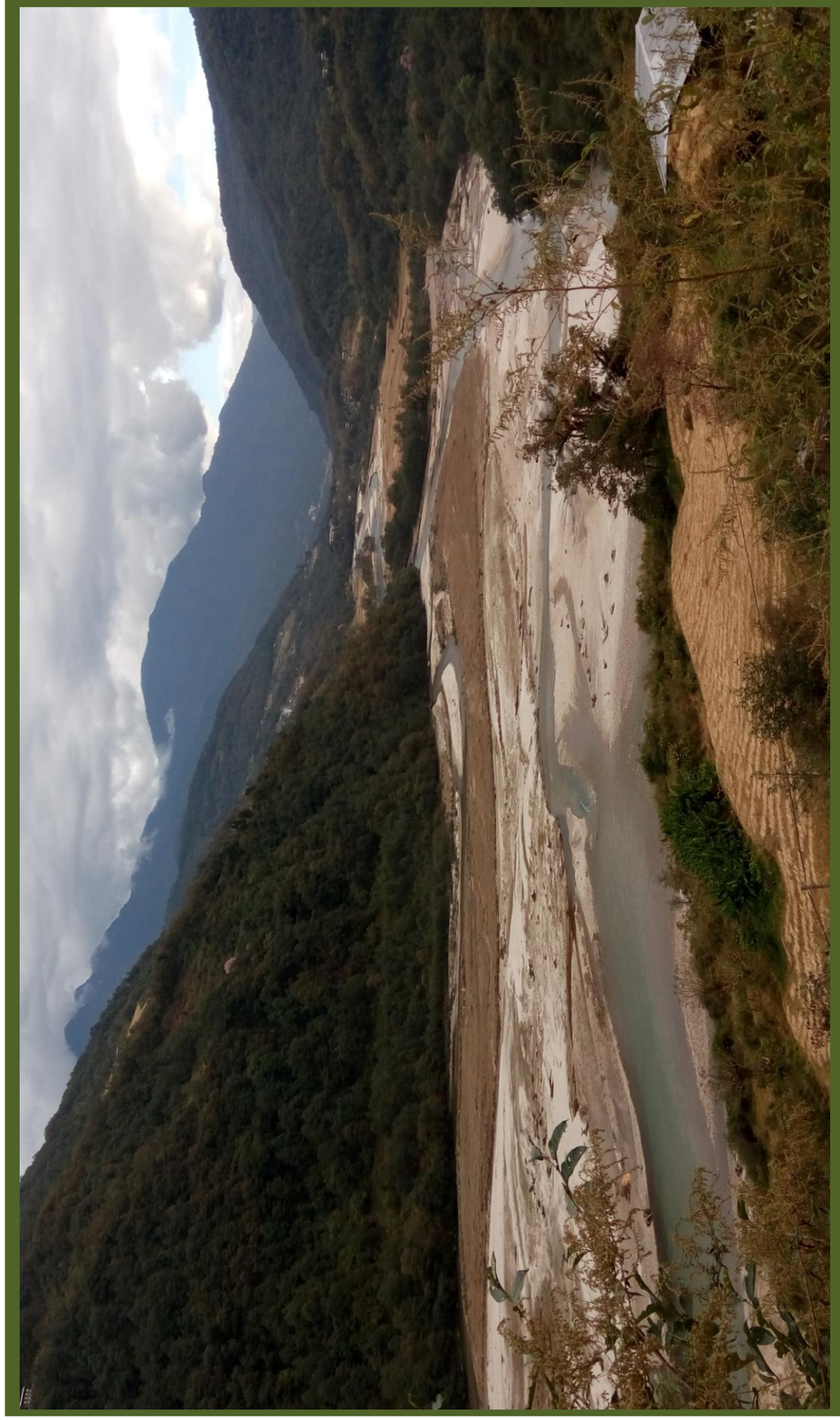
9. *Episoriculus caudatus* Horsfield, 1851

10. *Sorex minutus* Linnaeus, 1766

11. *Euroscaptor micrura* Hodgson, 1841

Small mammals are the largest order in class Mammalia. Small mammals play vital ecological roles and also act as bio-indicator species. This poster depicts 11 species under two families i.e. Muridae (7 rodent species, Fig. 1-7) and Soricidae (4 shrew species, Fig. 8-11). The small mammals of Bumdeling Ramar Site, Trashi Yangtse in Bhutan are being studied by Lam Norbu, Forestry Officer, DoFPS-2016.

Conserve and Protect Small Mammal



A Wetland of International Importance in Bhutan
Bumdeling Ramsar Site, Trashi Yangtse
Eastern Bhutan

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Small Mammal of Bumdeling Ramsar Site












Prepared by Lam Norbu
Forestry Officer
Trashi Yangtse Forest Range Office
Department of Forest and Park Service
Bhutan @ 2017

A WETLAND OF INTERNATIONAL IMPORTANCE IN BHUTAN: DIVERSITY AND ABUNDANCE OF TERRESTRIAL SMALL MAMMALS IN BUMDELING RAMSAR SITE (BRS), TRASHI YANGTSE, EASTERN BHUTAN.

Lam Norbu, (M.Sc. Forestry in Wildlife Management, 2014-2016), Forest Research Institute University, Dehra Dun, Uttarakhand- India.

Background

Small mammals are animal weighing ≤ 500g or 1 kg when adult (Barnett and Dutton, 1995). They are terrestrial and arboreal in nature, representing the largest Order in class Mammalia (Hoffmann *et al*., 2010). Of 3,821 species of small mammals (Hoffmann *et al.*, 2010) contributing ≈ 75% of the world's mammalian diversity (Molur and Singh, 2015). 3329 are terrestrial non-flying and contributed little over 50% (Molur and Singh, 2009). Wetland provision highest small mammal communities (Scott *et al*., 2008) and caters socio-economic needs of the people thus, represent an area of significant conservation importance.

Problem Statement

Lack of vital information on species diversity, ecology and conservation status of small mammals. Ecological studies in Bhutan focused only on higher profile taxa which appealed to conservation resources. Studies were conducted only in few of the PAs of Bhutan and proper checklist of small mammal assemblages of the country is non-existence. Wetland and Biodiversity Management Plan of Bumdeling Wildlife Sanctuary (BWS) lack information on species diversity of terrestrial small mammals in Bumdeling Ramsar Site (BRS).

Research Objectives

- Determine the species diversity and composition of terrestrial small mammals in BRS
- Assess key ecological variables that influences to the survival of small mammals in BRS
- Assess the conservation threats that influences to the survival of small mammals in BRS

Methods and Materials

- 255 meters transect lines were laid in five major ecosystems (Agricultural, Fallow land, Open Grassland, Riparian, Forest- Oak and Alder forest).
- 17 Sherman Live traps at an interval of 15 meters were set in respective study fields.
- Cane fish, salty fish, bread, flour, biscuit, apple, grapes, banana, ground nut and carrot.
- Traps were left consecutively for three trapping nights per transect in each study field.

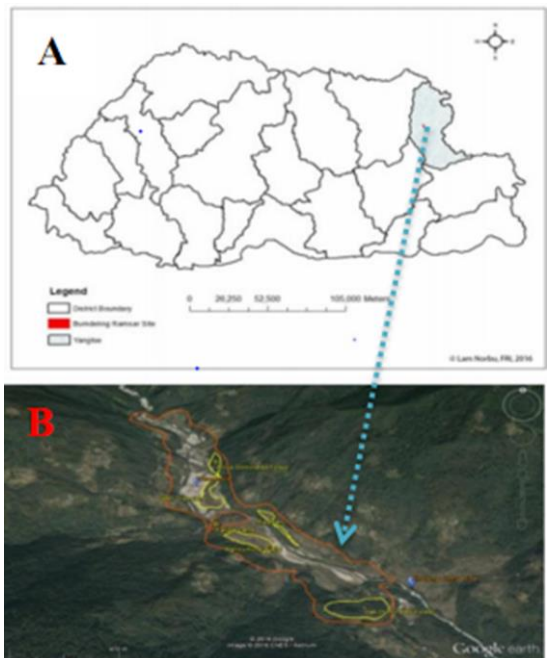

Figure 1: (**A**) Location of Trashi Yangtse District and Bumdeling Ramsar Site (BRS). (**B**) Intensive study site in BRS.

Results and Discusion

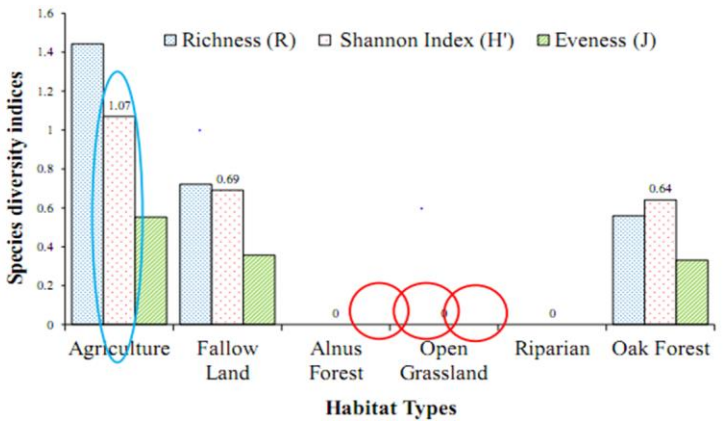

Figure 2: Specie diversity, richness and evenness of small mammals in BRS.

A total of 26 small mammal individuals were recorded and identified during 306 trap nights (17 traps per transect), belong to 7 species, mostly Rodentia (5 species and 23 individuals), 2 species of insectivora (3 individuals) . The species richeness was higher in Agricultural land (R=1.44) followed by Fallow land (R= 0.72), Oak forest (R= 0.56) and low in *Alnus* forest, Open grassland, Riparian (R=0) respectively. The number of animal recorded were 58% (n=15) on gentle slope (≤15°), 31% (n=8) on moderate (16-30°) and 12% (n=3) on steep slope (31°≥). The potential conservation threats observed in captured site during the study include 100% of grazing (n=18), 0% of stone collection (n=0), 8% of litter collection (n=4), 25% of timber extraction (n=13), 4% of fire (n=2), 25% of feral dog (n=13) and 4% of road (n=2).

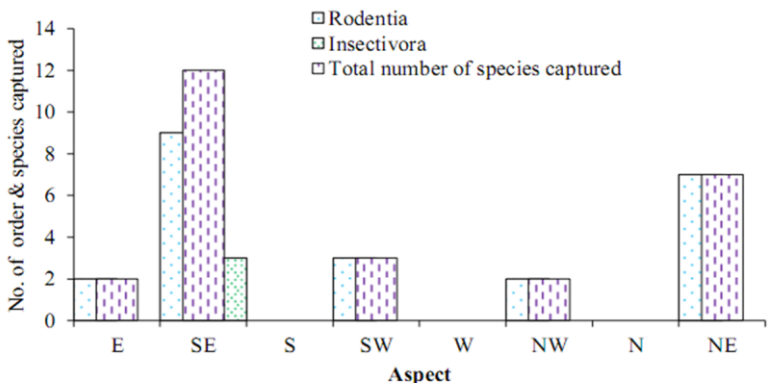

Figure 3: Response of small mammals to aspect

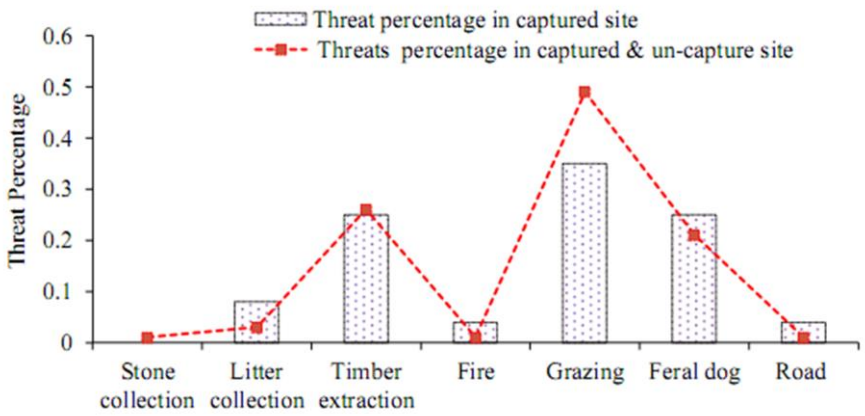

Figure 4: Types of conservation threats

Conclusion

The species diversity and relative abundance of small mammals were comparatively higher in Agricultural land and Fallow land. The number of small mammals was closely associated to habitat types, microhabitats, altitude, slope gradient and aspect. Small mammals positively responded to anthropogenic disturbance with high intensity of disturbance.

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Molur, S., and Singh, M. (2015). Non-volant Small Mammals of the Western Ghats of Coorg District, Southern India. *Journal of Threatened Taxa*, *1*(12), 589-608.

Scott, D.M., Joyce, C.B., and Bumside, N.G. (2008). The Influence of Habitat and Landscape on Small Mammals in Estonian coastal wetlands. *Estonian Journal of Ecology*, 4(57), 279-295.

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A Wetland of International Importance in Bhutan: Diversity and Abundance of Terrestrial Small Mammals in Bumdeling Ramsar Site, Trashi Yangtse, Eastern Bhutan.

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2016

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FOREST RESEARCH INSTITUTE DEHRADUN

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Presentation Outline

1.1. Introduction

- Overview
- Problem Statement
- Objectives
- Outcome of the study

2.1. Study Area

3.1. Materials and Methods

- Research Design
- Data collection
- Material Used for Ecological studies
- Data Analysis

4.1. Results and Discussion

5.1. Conclusion

6.1. Recommendations

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Introduction: Overview

- Small mammals are animal weighing less than 500g (Hoffmann *et al*., 2010; Dorji, 2015).
- They are terrestrial and arboreal in nature, representing the largest Order in class Mammalia (Barnett and Dutton, 1995).
- Of 4,434 species of mammals (Molur and Singh, 2015), small mammals encompassing of 3,821 species (Hoffmann *et al*., 2010) which constitute nearly 75% of the world's mammalian diversity (Molur and Singh, 2015), thus represents highest diversity worldwide.
- 3329 are terrestrial non-flying (non-volant) small mammals which contributes over 50% (Molur and Singh, 2015).

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Ecologically, small mammals are vital functional components of the ecosystems:

- Dynamic influence on vegetation regeneration (Garshong *et al*., 2013)
- Effects on structure and composition of forest (Batihun, 2012)
- Distributors of foliage and mycorrhizal fungal spores (Gupta, 2011)
- Pollination agents and biological control of pest (Cook, 2001)
- Bio-engineer of soils, mediate energy flow and nutrient cycling (Bergstrom, 2004),
- Connecting link between trophic level (Ofori, *et al*., 2015)
- Key prey species for carnivores and raptors (Davidson *et al*., 2012)
- Host for parasites and reservoir for the zoonotic pathogens (Karuaera, 2011).
- Interface between humans and nature (Angelici and Luiselli, 2005).
- Biological indicators-Biodiversity, Ecological & Environmental (Avenant, 2011)

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- Wetland provision highest small mammals communities (Dorji, 2015) and caters socio-economic needs of the people thus, represent an area of significant conservation importance.

Table 1. Status of Small mammals in worldwide, South Asia and two Neighbouring countries of Bhutan

Region	**Number of species**	**Percentage of mammal records**	**Source of information**
Worldwide	3821	75	Hoffmann *et al*., (2010)
South Asia	332	-	Srinivasulu *et al*., (2012)
India	120	66	Walker (2005)
Nepal	158	60	Katuwal and Koirala (2012)
Bhutan	44	20	Gyeltshen (2013), Dorji (2015)

Problem Statement

- Lack of vital information on small mammal species diversity, abundance, distribution and population status worldwide, more so in Bhutan (UWICE, 2011).
- Ecological studies in Bhutan focused only on higher profile taxa exclusively flagship species that appealed to conservation resources (RGoB, 2014).

- Studies were conducted only in few of the PAs of Bhutan viz. Jigme Dorji National Park (Gyeltshen, 2013), Royal Manas National Park (Wangmo *et al*., 2014) and High Altitude Wetland of Phobjikha (Dorji, 2015). Proper checklist of small mammals assemblages of the country is non-existence.

- The Management Plan to conserve Wetland habitat (Choden, 2012), Information of Ramsar Wetland (Ramsar, 2012) and Biodiversity Survey of Bumdeling Wildlife Sanctuary 2012 (Poel, 2013) lacks information on species diversity of terrestrial small mammals in Bumdeling Ramsar Site.

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Research Objectives

1. General objective:

- To assess the species diversity and understand the current status of terrestrial small mammals in Bumdeling Ramsar Site (BRS).

2. Specific objectives:

- To determine the species composition, diversity, abundance, distribution and status of terrestrial small mammals in BRS.
- To study the key environmental/ecological variables that affects to the survival of small mammals in BRS.
- To examine the potential ecological threats that affects to the survival of small mammals in BRS.

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Outcome of the Study

- Disseminate the baseline information of small mammals in relation to their habitat types and key ecological variables through various platforms.

- The checklist would benefits particularly Bumdeling Wildlife Sanctuary (BWS) and Bumdeling Range Office to improve conservation initiatives and strategies for small mammals and health of the wetland habitat used by Black Necked Crane (*Grus nigricollis*), riverine birds and biodiversity in general.

- Incorporate in Ramsar Information and Biodiversity Management Plan of BWS.

- Use as reference materials, cater to change the negative attitudes, influence research on small mammals and addressed conservation issues on small mammals of the small country.

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Study Area: Bhutan

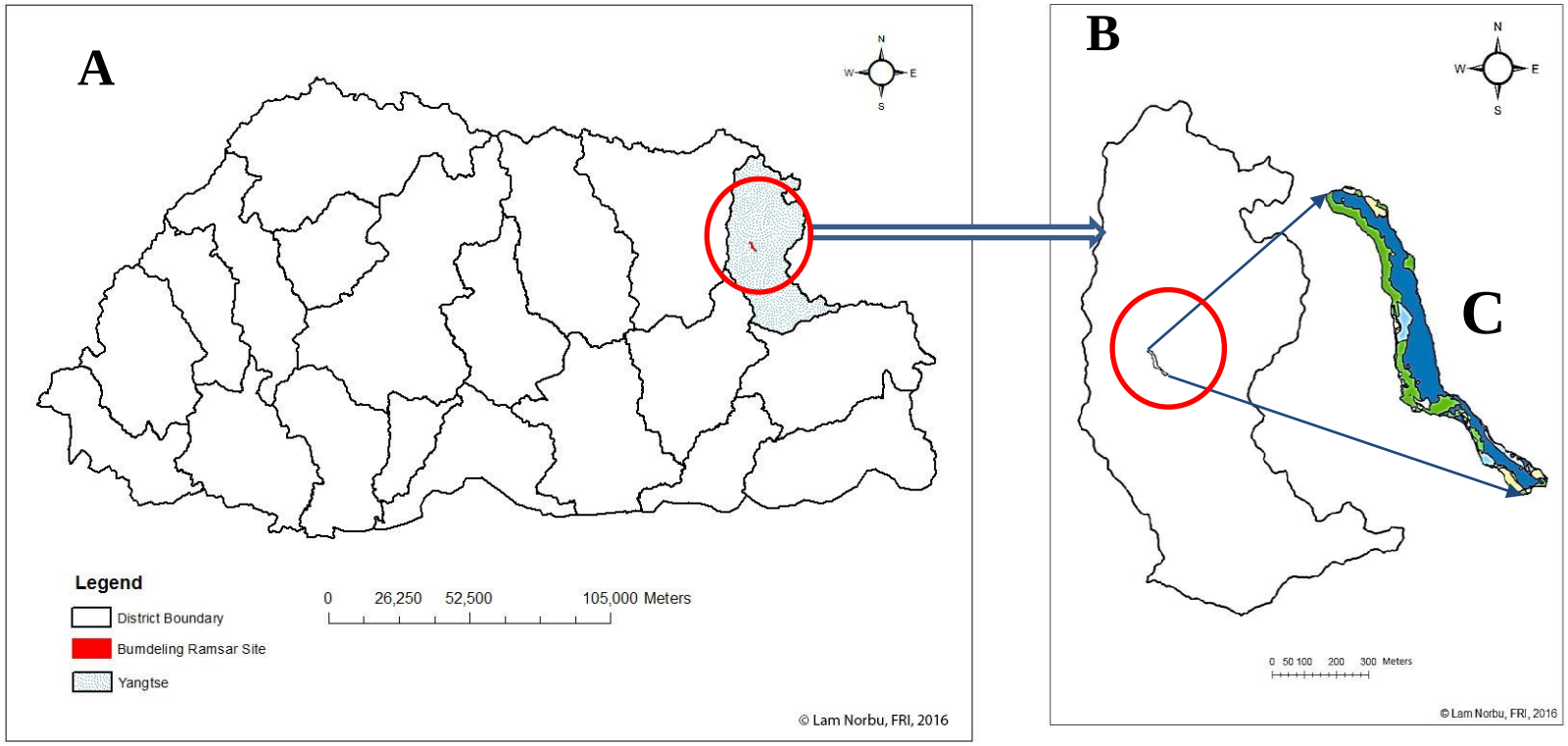

Figure 1. (**A**) Bhutan Map, (**B**) Trashi Yangtse District and (**C**) Bumdeling Ramsar Site

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Intensive Study Area: Bumdeling Ramsar Site (BRS)

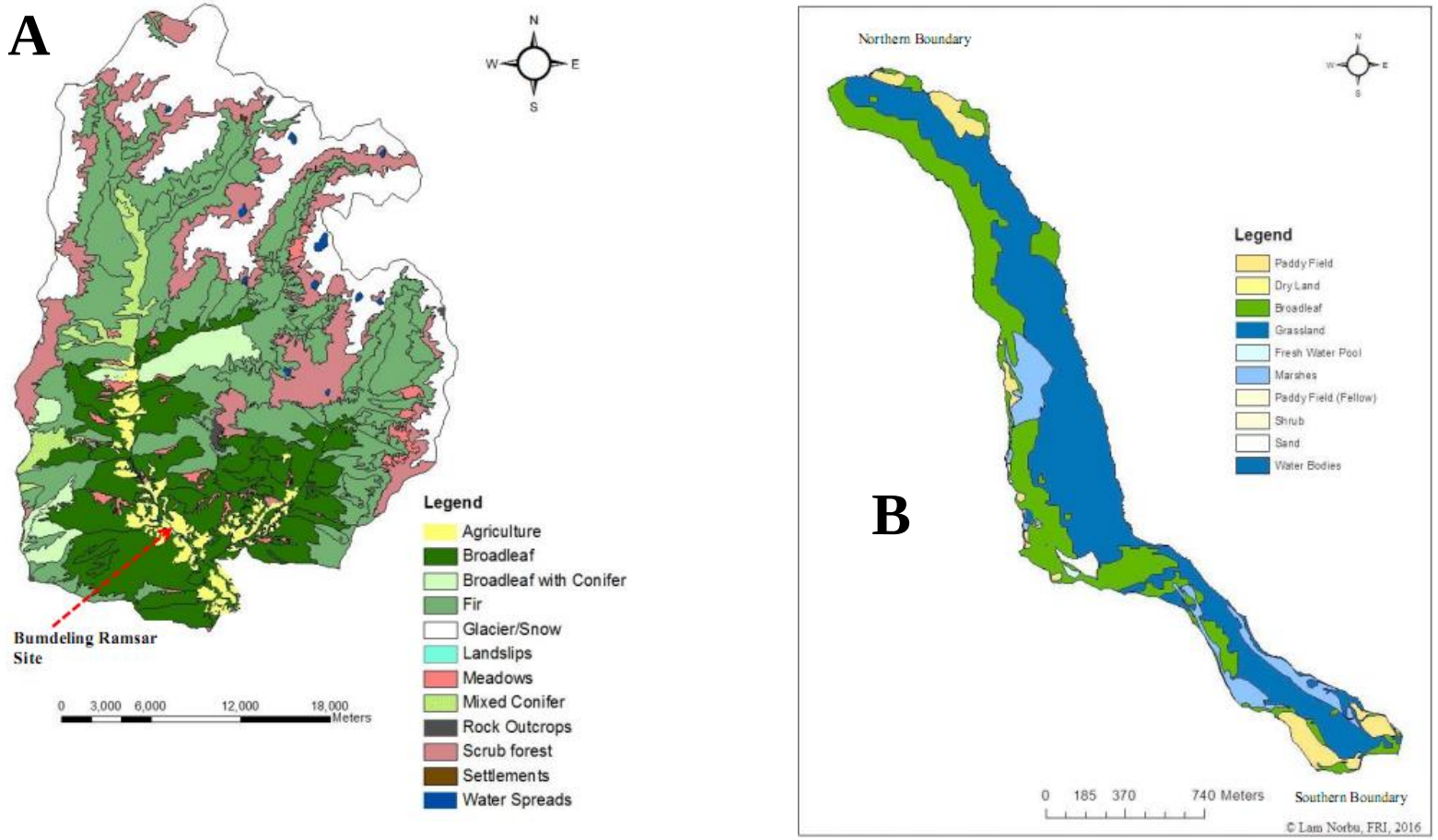

Figure 2. (**A**) Land use types of Bumdeling Block and (**B**) Bumdeling Ramsar Site

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Bumdeling Ramsar Site (BRS) No. 2032

- BRS area coverage: 142 hectares (1.42 km. sq.)
- Gazetted in 7 of September, 2012 as Ramsar site No. 1 in Bhutan
- Altitude: Min.1900 masl to Max. 2000 masl
- Coordinates: Longitude: $091^{0}26'28"E$, Latitude: $27^{0}40'23"N$
- Subtropical highland oceanic climate
- Temperature: maximum of 20.2^{0} and minimum of $10.7^{0}C$
- Winter roasting habitat for Black Neck Crane and other riverine birds

Consists of six different ecosystems:

- Agricultural Field
- Fallow Land
- Open Grassland
- Riparian/Riverine
- Forest: *Alnus nepalensis* (Alder) and *Quercus grafithii* (Oak) Dominated

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Table 2. Description of the study sites of each habitat types

Study Sites	Locations	Coordinates	Altitudes(m)	Vegetation Description
Agricultural land	Paddy field	27^{0}39'49.85" N 91^{0}26'43.73" E	1900-1912	Farm bushes, marshy, dry grass, crop residues, *Primula* sp.
Fallow Land	Archery ground	27^{0}39'56.84" N 91^{0}26'34.36" E	1900 - 1914	*Alnus* sp, *Elaeagnus parvifolia*, *Artemisia, Berberi, Peteridium*, *Clerodrendron* sp., herbage.
Alnus Forest	Along the trail	27^{0}40'35.0" N 91^{0}26'26.4" E	1921-1947	Young growth forest: *Alnus nepalensis*, *Rhododendron*, *Dhapna*, *Michelia*, *Quercus* sp, *Acer*, *Betula*, *Sellaginella,* etc.
Grassland	Roosting area	27^{0}40'18.5" N 091^{0}26'26.2"	1902-1905	Flooded area: dry grass, sedge, stumps, down log, *Primula sp.*
Riparian	Kholung Chhu	27^{0}39'59.1" N 91^{0}26'49.3" E	1903-1920	Grasses, sedge, shrub, *Alnus* sp, bamboo thickets, *Artemisia* sp.
Oak Forest	Dungtsho lake	27^{0}39'21.3" N 91^{0}27'12.2" E	1943-2027	Old growth forest: *Quercus* sp, *Rhododendron* sp, *Alnus* sp, *Corylopsis himalayana,*, *Betula*

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Research Design

Primary Data

- Primary study
- Habitat stratification and mapping
- Field sampling procedure
- Live trapping protocol for small mammals
- Data collection (Transect & Live trapping)
- Measurement of captured animal and species identification
- Vegetation and habitat assessment
- Conservation Threats assessment
- Safety consideration
- Material use for ecological studies
- Data analysis
- Results and Discussions
- Conclusion and Recommendations

Secondary Data

Literature review

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Study Design:- Intensive Study Site

Figure 3. Bumdeling Ramsar site showing different habitat types

Data Collection

1. Morphometric Measurement and Species Identification Parameters:

Species
Weight
Length
Sex
Age class
Breeding status

2. **Vegetation and Habitat Assessment:**

A). Habitat structure
Vegetation layer:- canopy, under-storey, ground cover.
B). Microhabitats: herbaceous, shrubs, herbaceous, trees, down logs, leave litters, rocks/gravels, bare ground, etc.
C). Ecological variables: slope, altitude, aspect, litter depth, temperature, GPS coordinates, etc.

Figure 4. (A) Trap in log microhabitat, (B) Live trap animal transferring to handling bag, (C) Weighing, (D) Measuring Head body length and (E) Sexing, age class and breeding status

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3. Conservation Threat Assessment:

A). Anthropogenic activities: grazing, fire, stone collection, timber/pole extraction, lopping, felling, litter collection, feral dog, road, etc.

B). Mammals/ungulates, Carnivores and raptors sign and evidences.

Figure 5. (A) Drawing Transect line

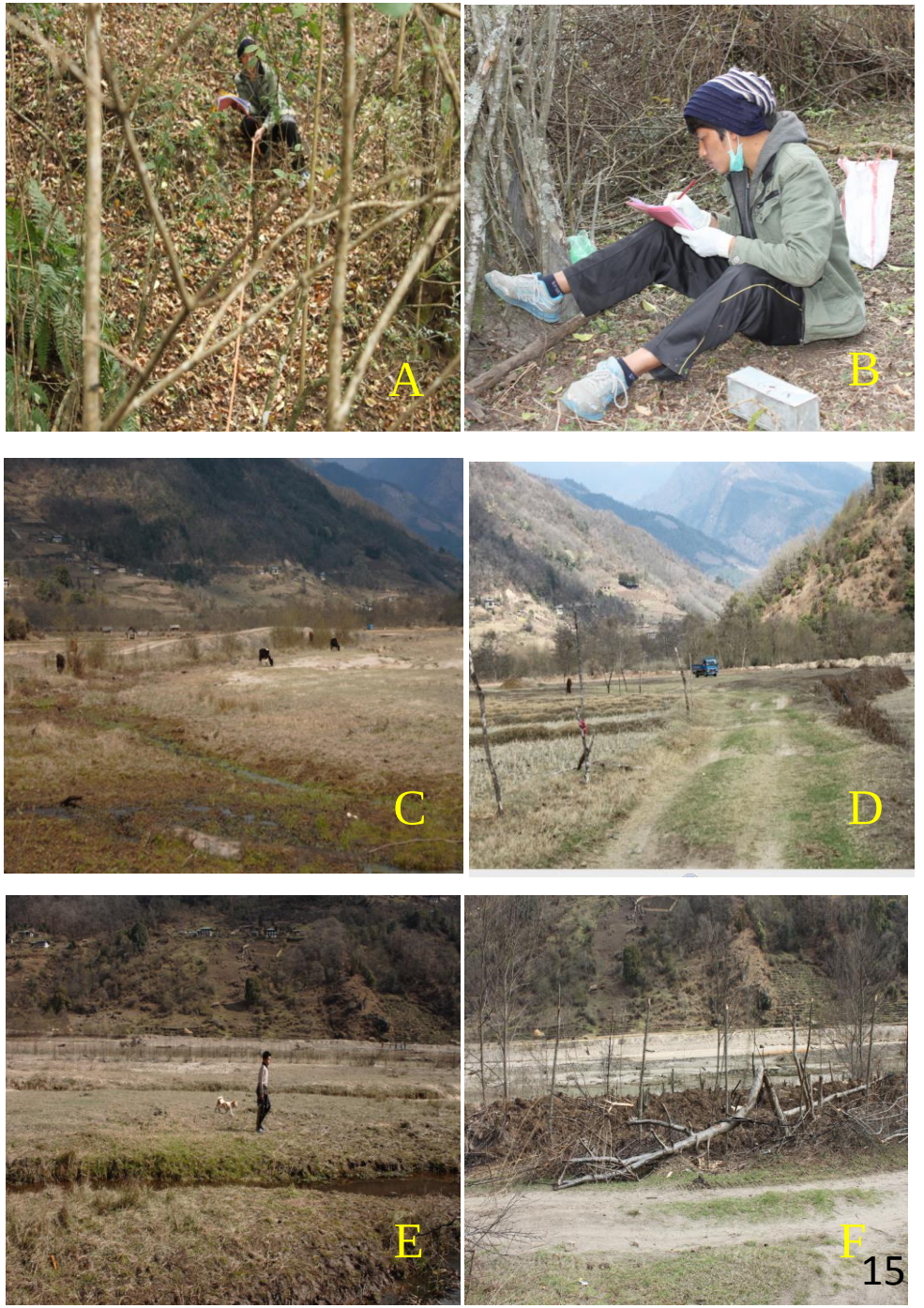
(B) Assessment and recording

(C) Grazing

(D) Road

(E) Feral Dog

(F) Pole extraction and felling



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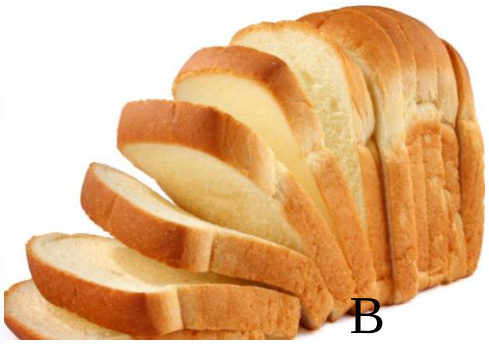
Materials used for Ecological Studies

Figure 6. (A) Sherman trap, (B) Pesola spring balance, (C) Stainless ruler, (D) Glove, (E) Data sheet, (F) Clinometer, (G) Compass, (H) Measuring tape, (I) GPS, (J) Flagging cloth

Animal Baits

A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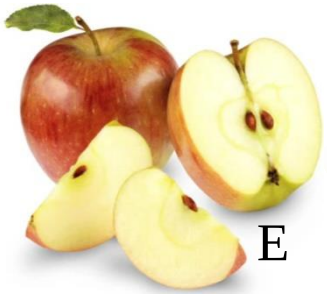
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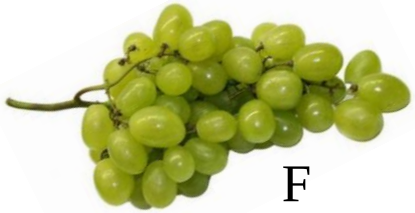
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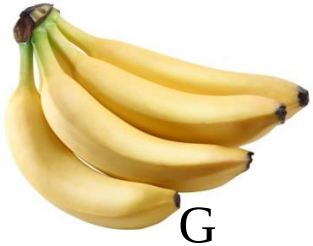
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H


I

Figure 7. (A) Cane fish, (B) Bread, (C) Flour, (D) Biscuit, (E) Apple, (F) Grapes, (G) Banana, (H) Ground nut and (I) Carrot.

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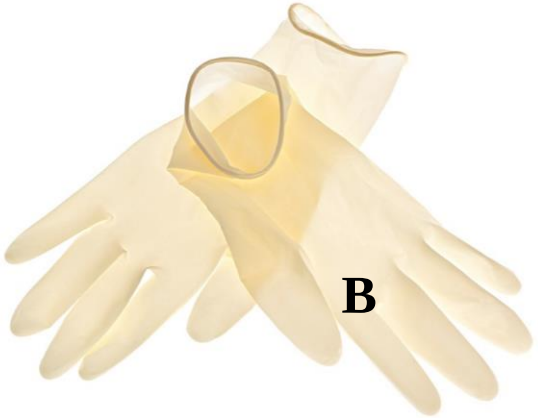
Safety Equipment

A



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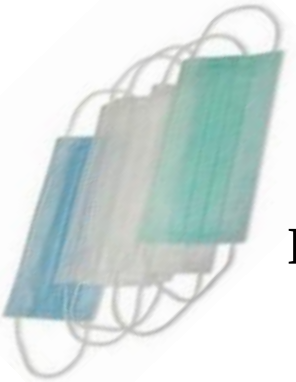

E

Figure: 8. (A) Hand sanitizer, (B) Gloves, (C) Soap and (D) Mash

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Data Analysis

1. Shannon Diversity Index

$(H') = -\sum \text{Pi ln pi}$

2. Evenness Index

$(J)\ \frac{H'}{H'max}$

3. Species Richness

$(R) = \frac{(S-1)}{\ln N}$

4. Relative abundance

$(Ar) = \frac{Tn \times 100}{TN}$

5. Trapping success

$(Ts) = \frac{TN \times 100}{Tn}$

Statistical Test:

1. One- sample t-test
2. Chi-square (x^2) test
3. Kruskal-Wallis (H) test
4. Pearson's correlation coefficient (r) test
5. Spearman's correlation coefficient (r_s) test

Others:

1. Descriptive statistic
2. Anova-Single factor
3. Regression analysis
4. Cluster analysis
4. Principal Component Analysis (PCA)

Software:

1. Excel, 2. Biodiversity calculator (2005), 3. Biodiversity Pro. (1997), 4. Software Statistica version 7 and 5. SPSS ver.20.

Results and Discussions:- Animal Captured

Figure 9. (A) *Rattus* sp.,(B) *Apodemus sylvaticus*, (C) *Mus musculus*, (D) *Talpa micrura*, (E) *Soriculus nigrescens*, (F) *Tatera indica* and (G) *Millardia meltada*.

Trapping Success and Sampling Effort

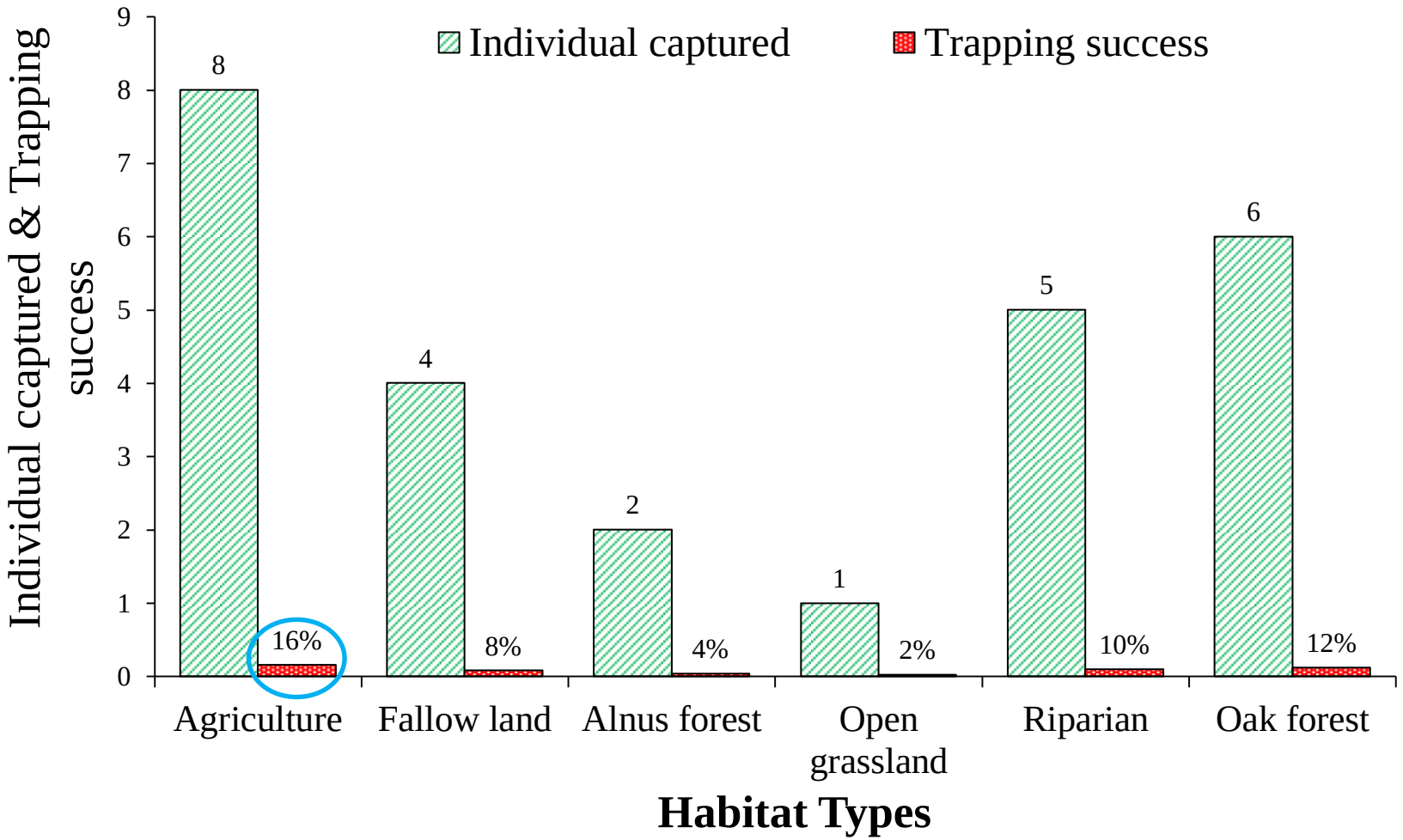

Figure 10. Individuals and trapping success in different habitat types

Table 3. Trap success of individual small mammal species and IUCN status

Species	Common Name	Status IUCN	No. of Individuals	Trap Success (%)
Rattus species	Rat	LC	14	4.6
Millardia meltada	Soft-furred metad	LC	2	0.7
Tatera indica	Indian gerbil	LC	1	0.3
Mus musculus	House mouse	LC	2	0.7
Apodemus sylvaticus	Wood mouse	LC	4	1.3
Soriculus nigrescens	Himalayan shrew	LC	2	0.7
Talpa micrura	Himalayan mole	LC	1	0.3
Total			26	8.6

*LC= Least Concern

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Abundance, Distribution and Species Composition

Table 4. Abundance and distribution of Live trapped small mammals from different habitats (figure in brackets show percentage)

Species	Abundance of small mammals from different habitat types						
	AG	FL	AF	OG	RR	OF	Total
Rattus species	5 (35.7)	-	2 (14.3)	-	5 (35.7)	2 (14.3)	14
Millardia meltada	-	2 (100)	-	-	-	-	2
Tatera indica	1 (100)	-	-	-	-	-	1
Mus musculus	-	2 (100)	-	-	-	-	2
Apodemus sylvaticus	-	-	-	-	-	4 (100)	4
Soriculus nigrescens	1 (50)	-	-	1 (50)	-	-	2
Talpa micrura	1 (100)	-	-	-	-	-	1
Total	8	4	2	1	5	6	26
Number of Species	4	2	1	1	1	2	7

AG= Agricultural land, FL= Fallow Land, AF= *Alnus* Forest, OG= Open grassland, RR= Riparian, OF= Oak Forest. LC= Least concern, (-) indicates no capture.

Species Diversity

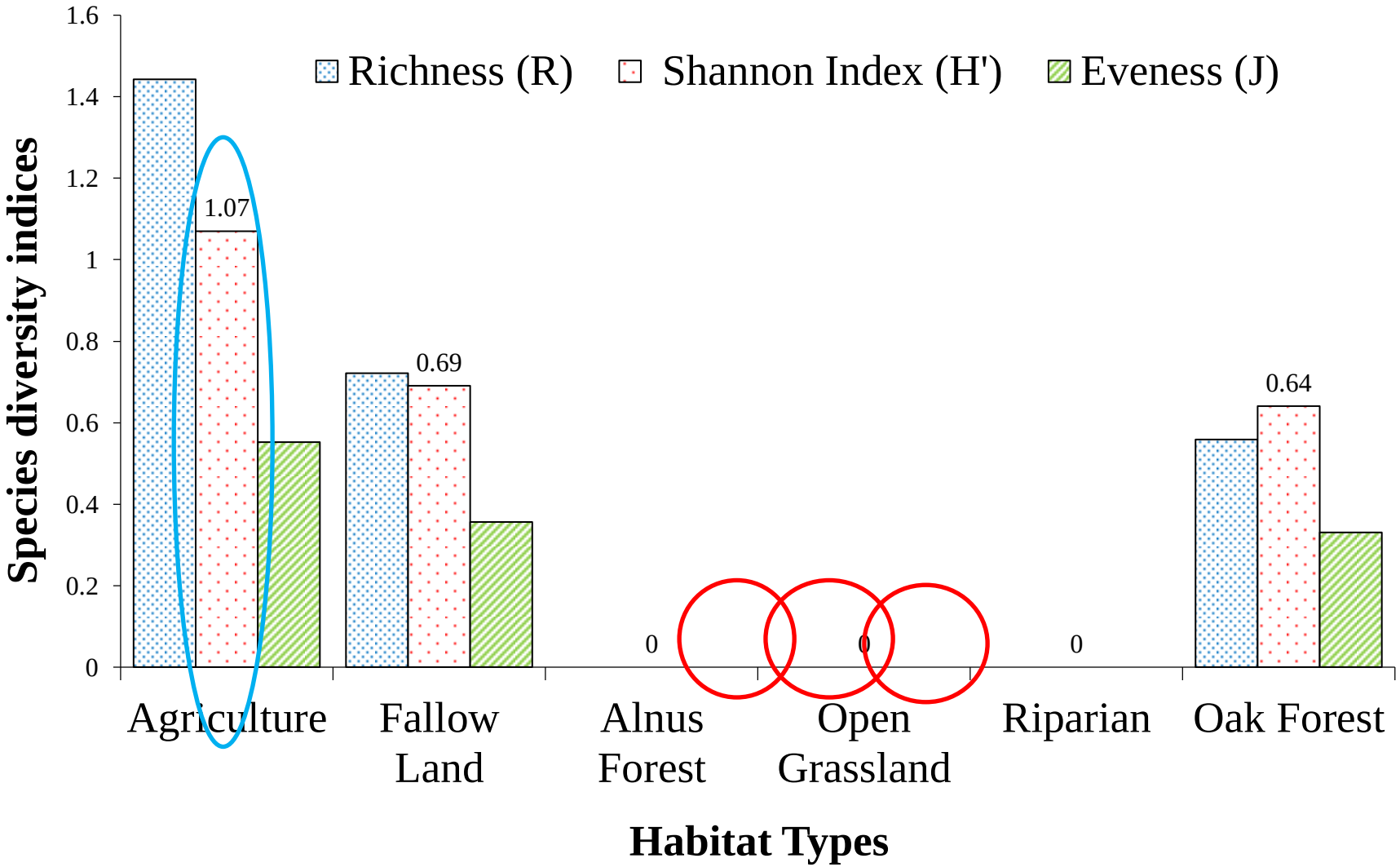

Figure 11. Species diversity, richness and evenness of small mammals in BRS

Small Mammals in Relation to Eco-geographical Variables

Table 5. Number of small mammals in retort to different slopes range in percentage

Order	Slope category			
	Gentle (≤ 15°)	Moderate (16° ≥ ≤30°)	Steep (31° ≥)	Total
Rodentia	12	8	3	23
Insectivora	3	0	0	3
Total	15	8	3	26
Percent	58%	31%	12%	

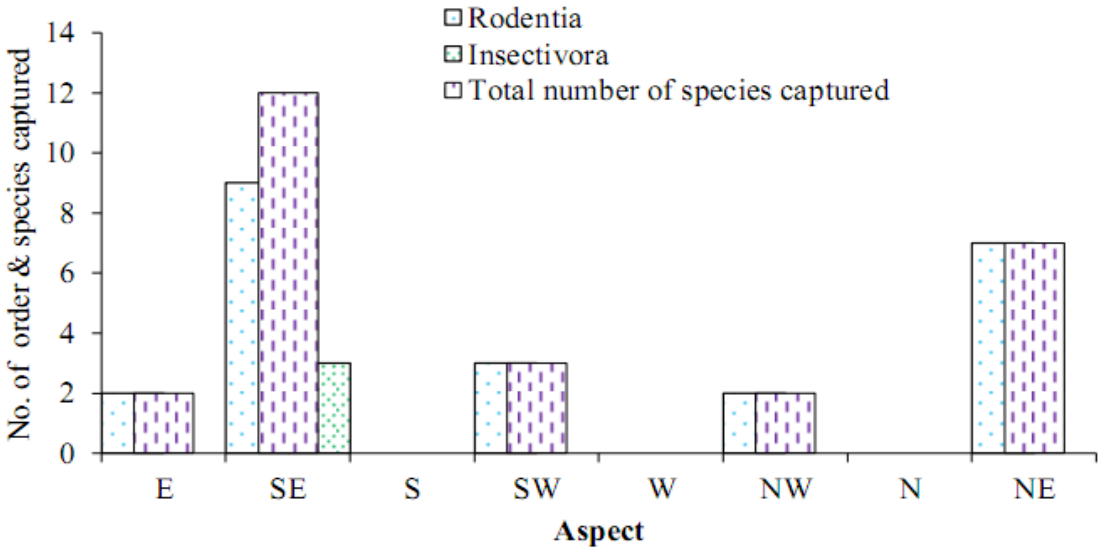

Figure 12. The response of small mammals to aspects

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Small Mammals and Altitude

Table 6: Number of small mammals at each altitude level at BRS

	Elevation (m)				
Species	1900	1920	1940	1960	1980
Rattus species	3	6	3	1	1
Millardia meltada	2	-	-	-	-
Tatera indica	1	-	-	-	-
Apodemus sylvaticus	-	-	2	2	-
Mus musculus	2	-	-	-	-
Soriculus nigrescens	2	-	-	-	-
Talpa micrure	1	-	-	-	-

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Distribution of Small Mammals in Relation to Vegetation cover

Table 7: Frequency of vegetation and ground covers class percentage in captured site

	Vegetation structures		
Cover class	Overstorey	Under storey	Ground cover
<1%	0.06	0.06	0.11
1-5%	0.12	0.18	0.18
6-25%	0.24	0.29	0.20
26-50%	0.35	0.35	0.19
51-75%	0.12	0.12	0.14
>75%	0.12	0.00	0.18

The abundance of small was probably insignificantly correlated with the over-storey vegetation classes (r= 0.203, df= 5, p>5%) and strongly negative association with under-storey vegetation cover classes (r= -0.162, df= 5, p<5%) and was probably insignificantly correlated with the ground cover classes (r= 0.34, df= 5, p>5%)

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Conservation Threats

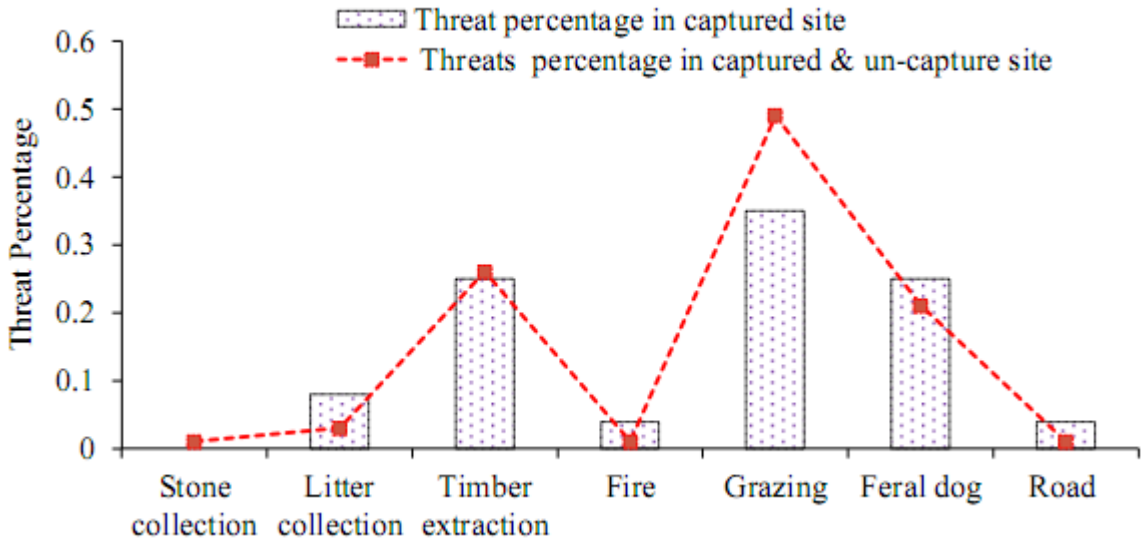

Figure 13. Types of conservation threats.

Statistically, tested result showed that there was a positive correlation between small animals and degree of disturbances (r_s=1, df =2, (p< 5%).

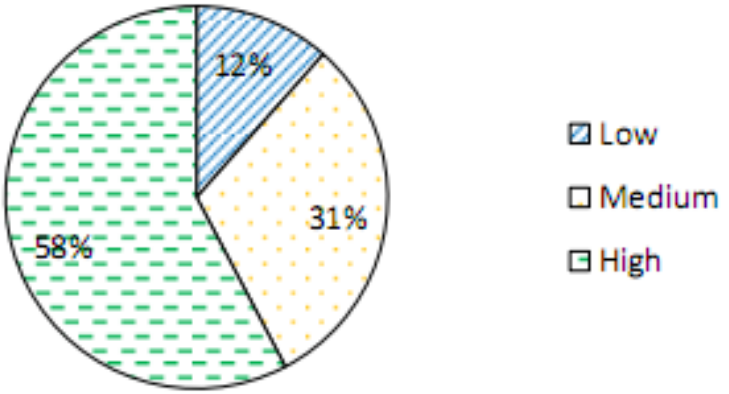

Figure 14. The Degree/Intensities of the disturbances

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Conclusion

- Variation in trap success among the habitat types. Overall trap success was 52%.
- Variation of species compositions among the habitat types, their distribution was not varied significantly.
- Difference in the diversity and abundance of small mammals among habitat types.
- The numbers of small mammals were related to habitat types (macro-habitats), microhabitats attributes and other key ecological variables.

- The presences of small mammals were closely associated with microhabitats attributes. Piled stones and down logs microhabitats were greater utilizations indicated by the presence of high number of small mammals.

- Small mammals responded highly towards gentle slope, lower altitude and high degree of disturbances.

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Recommendations

- Ecological study needs to be carried out further in those unstudied areas with sufficient trapping equipment and more sampling replication in each habitat types covering different season. Thus, the status of small mammals' population and species diversity in BRS could be rightly ascertained.

- Felling/lopping of trees in and around the conservation area need to be prohibited.

- The local communities needs of strong conservation awareness related to small mammals species conservation benefits other than focusing only to Black Necked Crane through Community Based Conservation Education (CBCE).

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THANK YOU!!!!