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ORIGINAL ARTICLE

FOREST MANAGEMENT AND BIODIVERSITY LOSS – A COMPREHENSIVE STUDY BETWEEN BANDIPUR AND MUDUMALAI FORESTS OF NILGIRI BIOSPHERE RESERVE

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Abstract: *Biodiversity or Biological diversity – is the term given to the variety and variability of life on Earth. It may be elaborated as the variety within and between all species of plants, animals and micro-organisms and the ecosystems within which they live and interact. However, losses of natural and semi-natural forests, mostly to unregulated developmental projects as well as agriculture, are a significant concern for biodiversity. Regional deforestation pressure for these developmental projects in various forests of India currently poses as an evil to various endemic species populations across forests in India. This leads towards a vicious cycle that involves severe events of man-animal conflict having disastrous consequences. In this study we chose two forests located in the Nilgiri Biosphere reserve – Bandipur in Karnataka and Mudumalai in Tamilnadu as our fields and made a comparative model study between them. The study revealed how differences in forest management standards can cause drastically different consequences on biodiversity even in two adjacent forests located within the same biosphere reserve.*

Keywords: Forest biodiversity loss, Nilgiri biosphere reserve, man-animal conflict, Bandipur, Mudumalai.

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1. INTRODUCTION

The individual components of biodiversity—genes, species, and ecosystems—provide our society with a wide array of services. Be it our food resources, our industrial products or our civilization as a whole unquestionably depends on biodiversity. However, unexpected changes in any ecosystem due to several anthropogenic reasons cause substantial risk of undesirable loss of biodiversity [1]. In a low to middle income country like India, deforestation and improper forest management has already caused loss of a significant amount of biodiversity in various parts of the country. In this study, we chose two adjacent forests located within Nilgiri Biosphere reserve – Bandipur in Karnataka and Mudumalai in Tamilnadu and made a comparative model study between them. The study revealed how differences in forest management standards can cause drastically different consequences on biodiversity even in two adjacent forests located within the same biosphere reserve.

2. METHODS

Quadrat Analysis

The study was performed as described previously by Fidelibus and Mac Aller [2]. After determining the locations for placement of the quadrat, a square of length 7.75 meter × 7.75 meter using a measuring tape was enclosed. A nylon rope was used to demarcate its boundaries. The enclosed square quadrat was then subdivided into 5 sub-quadrats of length – 7.75 meters and breadth – 1.55 meters (Figure 1). The number of plant species within their respective sub-quadrats was recorded. The collected data were then used to estimate the quantitative characters of the community, biodiversity indices and for determining community similarities. Similar quadrats were constructed at 10 randomly chosen locations.

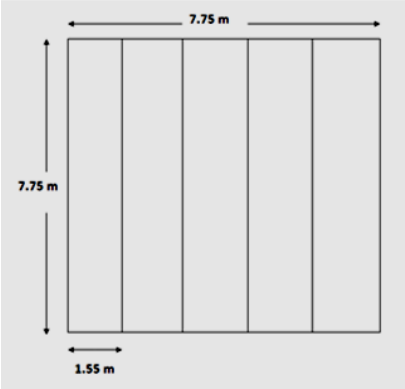

Figure 1: Schematic diagram of a quadrat

Analysis of Community Similarity

Community similarity among the study sites were calculated by Sorenson's co-efficient [3].

Soil texture analysis

The study was performed according the protocol described by Brom *et al*. [4].

Pitfall trap Analysis

The study was performed following New, 1990 [5].

Study of canopy cover

The study was performed following the protocol of Korhonen *et al*. [6].

Study of Zooplankton Community

The study was performed following the protocol described by Barnadi [7].

Survey work to analyse eco sensitive zone

The survey work was conducted based on the questionnaire prepared by Ministry of Environment and Forests, Govt. Of India [F No. 1-9/2007 WL-I(pt)] dated 9.02.2011. Students were divided into five groups and asked questions to the local residents, students as well as forest guards.

Statistical Analysis

The collected data was analysed with the help of MS-Excel (Microsoft, USA).

3. RESULTS AND DISCUSSION

A. Comparison of diversity indices

Quadrate analysis revealed significantly different results at Bandipur and Mudumalai. Species richness was significantly higher at Mudumalai compared to Bandipur. Besides this, the value of Shannon-Weiner diversity index was also higher at Mudumalai. The study also revealed higher species evenness value at Mudumalai. On the other hand, Bandipur had a higher Simpson's dominance index. All these data cumulatively indicate towards significantly higher diversity at Mudumalai compared to Bandipur.

Table 1: List of plant specimens observed within the quadrat along with corresponding number of individuals found in each sub-quadrat in Bandipur Study site 1.

Plant Code	*Scientific name*	*Family*	*Group 1*	*Group 2*	*Group 3*	*Group 4*	*Group 5*	*Total*
A	*Stachytarpeta indica*	*Verbenecaea*	2	6	7	10	24	49
B	*Tephrosia purpurea*	*Fabaceae*	28	20	17	2	8	75
C	*UIS-1*	*X*	6	5	2	1	1	15
D	*Cassia tora*	*Fabaceae*	23	14	0	0	0	37
E	*Micarpus villosus*	*Rubiaceae*	1	3	4	0	3	11
F	*Parthenium hysterphorus*	*Asteraceae*	9	8	2	0	0	19
G	*Lantana camara*	*Verbenaceae*	10	5	4	2	1	22
H	*Indigophera prostrata*	*Fabaceae*	0	1	1	0	0	2
I	*Sphaeranthus indicus*	*Asteraceae*	0	5	0	0	0	5
J	*Flacourtia indica*	*Salicaceae*	0	1	3	0	3	7
K	*Tridax procumbens*	*Asteraceae*	0	3	0	0	0	3
L	*Ruellia tuberosa*	*Acanthaceae*	0	0	3	0	0	3
M	*UIS-2*	*X*	0	0	1	0	0	1
N	*Sida cordifolia*	*Malvaceae*	0	0	1	0	0	1
O	*Caesalpinia sp.*	*Fabaceae*	0	0	0	11	0	11
P	*Emilia sonchifolia*	*Asteraceae*	0	0	0	1	0	1
Q	*Cleome sp.*	*Capparaceae*	0	0	0	5	0	5

(UIS- Unidentified specimen); (Groups designate student groups assigned for each sub-quadrat)

Table 2: Calculation of quantitative characters of community from the data obtained by quadrat study at Bandipur Study site 1.

SPECIES CODE	No. of Sampling Units in which the Species occurred	FREQUENCY %	Raunkaier's Class	RELATIVE FREQUENCY (RFR)	Total Number of Individuals	DENSITY	RELATIVE DENSITY (RDE)	ABUNDANCE	RELATIVE ABUNDANCE (RA)	IVI= RFR+RDE+RA
A	5	100	E	11.9047619	49	980	18.35205993	980	10.52442795	40.78
B	5	100	E	11.9047619	75	1500	28.08988764	1500	16.10881829	56.1
C	5	100	E	11.9047619	15	300	5.617977528	300	3.221763658	20.74
D	2	40	B	4.761904762	37	740	13.8576779	1850	19.86754256	38.49
E	4	80	D	9.523809524	11	220	4.119850187	275	2.953283353	16.6
F	3	60	C	7.142857143	19	380	7.116104869	633.3333333	6.801501055	21.06
G	5	100	E	11.9047619	22	440	8.239700375	440	4.725253365	24.87
H	2	40	B	4.761904762	2	40	0.74906367	100	1.073921219	6.585
I	1	20	A	2.380952381	5	100	1.872659176	500	5.369606096	9.623
J	3	60	C	7.142857143	7	140	2.621722846	233.3333333	2.505816178	12.27
K	1	20	A	2.380952381	3	60	1.123595506	300	3.221763658	6.726
L	1	20	A	2.380952381	3	60	1.123595506	300	3.221763658	6.726
M	1	20	A	2.380952381	1	20	0.374531835	100	1.073921219	3.829
N	1	20	A	2.380952381	1	20	0.374531835	100	1.073921219	3.829
O	1	20	A	2.380952381	11	220	4.119850187	1100	11.81313341	18.31
P	1	20	A	2.380952381	1	20	0.374531835	100	1.073921219	3.829
Q	1	20	A	2.380952381	5	100	1.872659176	500	5.369606096	9.623
Total	42				267	5340		9311.666667		

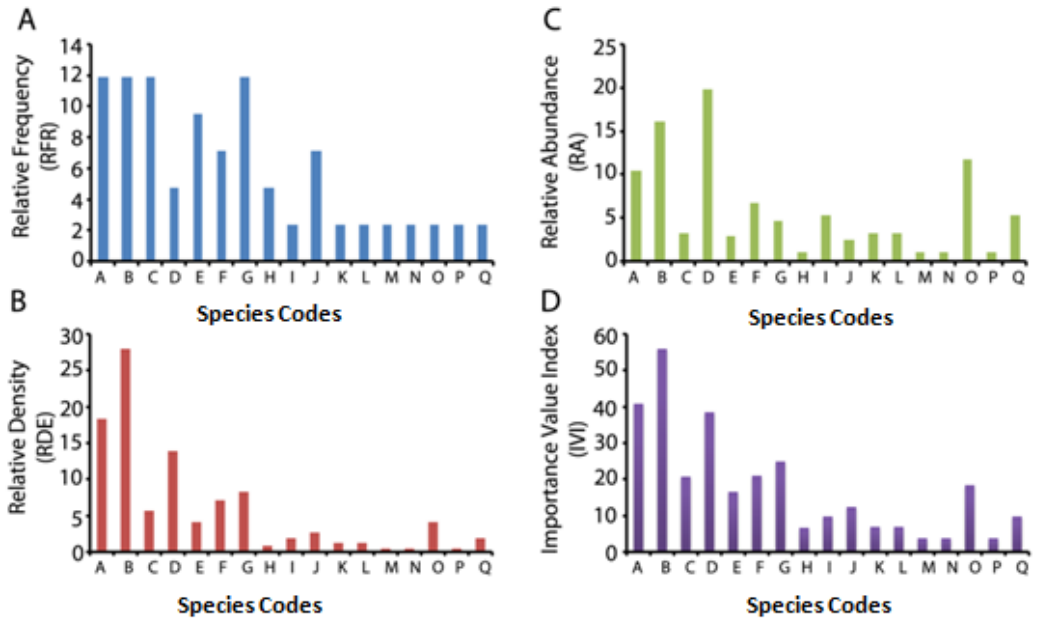

Figure 2: A) Relative Frequency, B) Relative Density, C) Relative Abundance and D) Importance value index of the community studied by quadrat sampling at Bandipur Study site 1.

Table 3: Calculation of diversity indices from the data obtained by quadrat study at Bandipur Study site 1.

Plant Code	***Scientific name***	***Family***	**Total Number (n)**	***n(n-1)***	***pi=n/N***	***ln(pi)***	***pi*ln(pi)***
A	*Stachytarpeta indica*	*Verbenecaea*	49	2352	0.183521	-1.6954284	-0.31115
B	*Tephrosia purpurea*	*Fabaceae*	75	5550	0.280899	-1.2697605	-0.35667
C	*UIS-1*	*X*	15	210	0.05618	-2.8791985	-0.16175
D	*Cassia tora*	*Fabaceae*	37	1332	0.138577	-1.9763307	-0.27387
E	*Micarpus villosus*	*Rubiaceae*	11	110	0.041199	-3.1893534	-0.1314
F	*Parthenium hysterphorus*	*Asteraceae*	19	342	0.071161	-2.6428097	-0.18807
G	*Lantana camara*	*Verbenaceae*	22	462	0.082397	-2.4962062	-0.20568
H	*Indigophera prostrata*	*Fabaceae*	2	2	0.007491	-4.8941015	-0.03666
I	*Sphaeranthus indicus*	*Asteraceae*	5	20	0.018727	-3.9778107	-0.07449
J	*Flacourtia indica*	*Salicaceae*	7	42	0.026217	-3.6413385	-0.09547
K	*Tridax procumbens*	*Asteraceae*	3	6	0.011236	-4.4886364	-0.05043
L	*Ruellia tuberosa*	*Acanthaceae*	3	6	0.011236	-4.4886364	-0.05043
M	*UIS-2*	*X*	1	0	0.003745	-5.5872487	-0.02093
N	*Sida cordifolia*	*Malvaceae*	1	0	0.003745	-5.5872487	-0.02093
O	*Caesalpinia sp.*	*Fabaceae*	11	110	0.041199	-3.1893534	-0.1314
P	*Emilia sonchifolia*	*Asteraceae*	1	0	0.003745	-5.5872487	-0.02093
Q	*Cleome sp.*	*Capparaceae*	5	20	0.018727	-3.9778107	-0.07449
Total (N)			267	10564		**Total**	-2.20474
		N(N-1)	71022				

Calculation of Diversity Indices-

Simpson's Index= $D = \frac{\Sigma\, n(n-1)}{N(N-1)}$ =0.148742643

Simpson's Diversity Index= 1-D= 0.851257357

Shannon Wiener Diversity Index (H) = -Σpi.ln (pi) =2.20474

H_{max}=ln (number of species) = 2.833; Evenness = H/H_{max}= 0.778

Table 4: List of plant specimens observed within the quadrat along with corresponding number of individuals found in each sub-quadrat at Bandipur Study Site 2.

Plant Code	*Scientific name*	*Family*	*Group 1*	*Group 2*	*Group 3*	*Group 4*	*Group 5*	*Total*
A	*Stachytarpeta indica*	*Verbenecaea*	6	11	5	6	12	40
B	*Tephrosia purpurea*	*Fabaceae*	0	0	0	0	8	8
E	*Micarpus villosus*	*Rubiaceae*	5	0	0	2	0	7
G	*Lantana camara*	*Verbenaceae*	6	0	3	6	10	25
H	*Indigophera prostrata*	*Fabaceae*	0	0	0	5	0	5
J	*Flacourtia indica*	*Salicaceae*	0	0	0	1	0	1
K	*Tridax procumbens*	*Asteraceae*	0	0	0	2	0	2
Q	*Cleome sp.*	*Capparaceae*	3	0	0	0	0	3
R	*Ziziphus sp.*	*Rhamnaceae*	3	1	1	1	0	6
S	*Crotalaria prosptrata*	*Fabaceae*	2	0	0	0	0	2
T	*Crotalaria hirsuta*	*Fabaceae*	3	3	2	0	0	8
U	*Caesalpinia pulcherrima*	*Fabaceae*	0	1	0	0	0	1
V	*UIS-3*	*X*	0	0	0	0	6	6
W	*UIS-4*	*X*	0	0	0	0	6	6
X	*UIS-5*	*X*	0	0	0	0	14	14
Y	*UIS-6*	*X*	0	0	0	0	4	4

UIS- Unidentified specimen); (Groups designate student groups assigned for each sub-quadrat)

Table 5: Calculation of quantitative characters of community from the data obtained by quadrat study at Bandipur Study Site 2.

SPECIES CODE	No. of Sampling Units in which the Species occurred	FREQUENCY %	Raunkaier's Class	RELATIVE FREQUENCY (RFR)	Total Number of Individuals	DENSITY	RELATIVE DENSITY (RDE)	ABUNDANCE	RELATIVE ABUNDANCE (RA)	IVI= RFR+RDE+RA
A	5	100	E	17.24137931	40	800	28.985507	800	10.82299399	57.05
B	1	20	A	3.448275862	8	160	5.7971014	800	10.82299399	20.07
E	2	40	B	6.896551724	7	140	5.0724638	350	4.735059871	16.7
G	4	80	D	13.79310345	25	500	18.115942	625	8.455464056	40.36
H	1	20	A	3.448275862	5	100	3.6231884	500	6.764371245	13.84
J	1	20	A	3.448275862	1	20	0.7246377	100	1.352874249	5.526
K	1	20	A	3.448275862	2	40	1.4492754	200	2.705748498	7.603
Q	1	20	A	3.448275862	3	60	2.173913	300	4.058622747	9.681
R	4	80	D	13.79310345	6	120	4.3478261	150	2.029311373	20.17
S	1	20	A	3.448275862	2	40	1.4492754	200	2.705748498	7.603
T	3	60	C	10.34482759	8	160	5.7971014	266.6666667	3.607664664	19.75
U	1	20	A	3.448275862	1	20	0.7246377	100	1.352874249	5.526
V	1	20	A	3.448275862	6	120	4.3478261	600	8.117245494	15.91
W	1	20	A	3.448275862	6	120	4.3478261	600	8.117245494	15.91
X	1	20	A	3.448275862	14	280	10.144928	1400	18.94023949	32.53
Y	1	20	A	3.448275862	4	80	2.8985507	400	5.411496996	11.76
Total	29				138	2760		7391.666667		

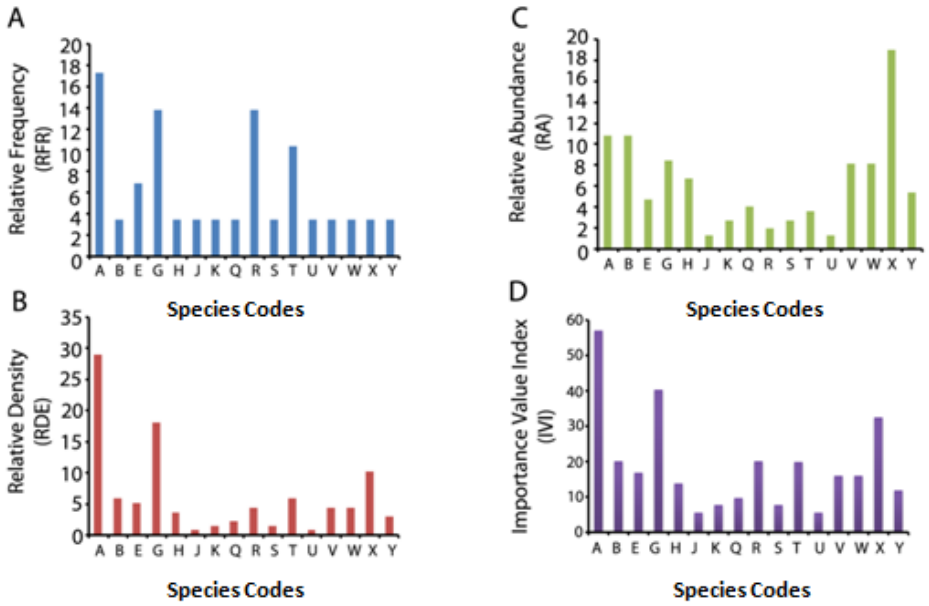

Figure 3: A) Relative Frequency, B) Relative Density, C) Relative Abundance and D) Importance value index of the community studied by quadrat sampling at Bandipur study site 2.

Table 6: Calculation of diversity indices from the data obtained by quadrat study at Bandipur study site 2.

Plant Code	*Scientific name*	*Family*	Total Number (n)	*n(n-1)*	*pi=n/N*	*ln(pi)*	*pi*ln(pi)*
A	*Stachytarpeta indica*	*Verbenecaea*	40	1560	0.289855	-1.2383742	-0.35895
B	*Tephrosia purpurea*	*Fabaceae*	8	72	0.057971	-2.8478121	-0.16509
E	*Micarpus villosus*	*Rubiaceae*	7	42	0.050725	-2.9813435	-0.15123
G	*Lantana camara*	*Verbenaceae*	25	600	0.181159	-1.7083779	-0.30949
H	*Indigophera prostrata*	*Fabaceae*	5	20	0.036232	-3.3178158	-0.12021
J	*Flacourtia indica*	*Salicaceae*	1	0	0.007246	-4.9272537	-0.0357
K	*Tridax procumbens*	*Asteraceae*	2	2	0.014493	-4.2341065	-0.06136
Q	*Cleome sp.*	*Capparaceae*	3	6	0.021739	-3.8286414	-0.08323
R	*Ziziphus sp.*	*Rhamnaceae*	6	30	0.043478	-3.1354942	-0.13633
S	*Crotalaria prosptrata*	*Fabaceae*	2	2	0.014493	-4.2341065	-0.06136
T	*Crotalaria hirsuta*	*Fabaceae*	8	56	0.057971	-2.8478121	-0.16509
U	*Caesalpinia pulcherrima*	*Fabaceae*	1	0	0.007246	-4.9272537	-0.0357
V	*UIS-3*	*X*	6	30	0.043478	-3.1354942	-0.13633
W	*UIS-4*	*X*	6	30	0.043478	-3.1354942	-0.13633
X	*UIS-5*	*X*	14	182	0.101449	-2.2881964	-0.23214
Y	*UIS-6*	*X*	4	12	0.028986	-3.5409593	-0.10264
Total (N)			138	2644		*?pi*ln(pi)*	-2.29118

Calculation of Diversity Indices-

Simpson's Index= $D = \frac{\Sigma\, n(n-1)}{N(N-1)}$ =0.139849783

Simpson's Diversity Index= 1-D= 0.860150217

Shannon Wiener Diversity Index (H) = -Σpi.ln (pi) =2.29118

Hmax=ln (number of species) = 2.772588722;

Evenness= H/Hmax= 0.826368506

Table 7: List of plant specimens observed within the quadrat along with corresponding number of individuals found in each sub-quadrat at Mudumalai study site.

Plant Code	*Scientific name*	*Family*	*Group 1*	*Group 2*	*Group 3*	*Group 4*	*Group 5*	*Total*
D	*Cassia tora*	*Fabaceae*	6	0	0	1	0	7
F	*Parthenium hysterphorus*	*Asteraceae*	1	0	0	0	0	1
Z	*UIS-7*	*X*	2	6	2	0	4	14
A1	*Sonchus asper*	*Asteraceae*	1	0	2	1	0	4
B1	*Leucas procumbens*	*Lamiaceae*	2	0	2	0	3	7
C1	*UIS-8*	*X*	2	40	0	8	0	50
D1	*Plectranthus incanus*	*Lamiaceae*	11	0	0	0	0	11
E1	*Eupatorium odoratum*	*Asteraceae*	19	25	6	19	18	87
F1	*Eclipta alba*	*Asteraceae*	0	1	0	0	11	12
G1	*Oplismenus burmanii*	*Poaceae*	0	4	0	0	0	4
H1	*Cryptolepis buchanani*	*Apocynaceae*	0	5	0	0	0	5
I1	*Leucas mollissima*	*Lamiaceae*	0	6	0	0	0	6
J1	*Ficus hispida*	*Moraceae*	0	1	8	3	0	12
K1	*Solanum sp.*	*Solanaceae*	0	0	14	0	0	14
L1	*UIS-9*	*X*	0	0	0	1	0	1
M1	*UIS-10*	*X*	0	0	0	3	0	3
N1	*Aeschynomene indica*	*Fabaceae*	0	0	0	2	0	2
O1	*Leonurus sibiricus*	*Lamiaceae*	0	0	0	1	0	1
P1	*UIS-11*	*X*	0	0	0	1	0	1
Q1	*UIS-12*	*X*	0	0	0	2	0	2
R1	*Dodonaea viscosa*	*Sapindaceae*	0	0	0	2	3	5
S1	*UIS-13*	*x*	0	0	0	1	5	6
T1	*UIS-14*	*x*	0	0	0	0	16	16

(UIS- Unidentified specimen); (Groups designate student groups assigned for each sub-quadrat)

Table 8: Calculation of quantitative characters of community from the data obtained by quadrat study at site 2.

SPECIES CODE	No. of Sampling Units in which the Species occurred	FREQUENCY %	Raunkaier's Class	RELATIVE FREQUENCY (RFR)	Total Number of Individuals	DENSITY	RELATIVE DENSITY (RDE)	ABUNDANCE	RELATIVE ABUNDANCE (RA)	IVI= RFR+ RDE+ RA
D	2	40	B	4.76190476	7	140	2.5830258	350	2.750851461	10.1
F	1	20	A	2.38095238	1	20	0.3690037	100	0.78595756	3.54
Z	4	80	D	9.52380952	14	280	5.1660517	350	2.750851461	17.4
A1	3	60	C	7.14285714	4	80	1.4760148	133.3333333	1.047943414	9.67
B1	3	60	C	7.14285714	7	140	2.5830258	233.3333333	1.833900974	11.6
C1	3	60	C	7.14285714	50	1000	18.450185	1666.666667	13.09929267	38.7
D1	1	20	A	2.38095238	11	220	4.0590406	1100	8.645533164	15.1
E1	5	100	E	11.9047619	87	1740	32.103321	1740	13.67566155	57.7
F1	2	40	B	4.76190476	12	240	4.4280443	600	4.715745362	13.9
G1	1	20	A	2.38095238	4	80	1.4760148	400	3.143830241	7
H1	1	20	A	2.38095238	5	100	1.8450185	500	3.929787802	8.16
I1	1	20	A	2.38095238	6	120	2.2140221	600	4.715745362	9.31
J1	3	60	C	7.14285714	12	240	4.4280443	400	3.143830241	14.7
K1	1	20	A	2.38095238	14	280	5.1660517	1400	11.00340584	18.6
L1	1	20	A	2.38095238	1	20	0.3690037	100	0.78595756	3.54
M1	1	20	A	2.38095238	3	60	1.1070111	300	2.357872681	5.85
N1	1	20	A	2.38095238	2	40	0.7380074	200	1.571915121	4.69
O1	1	20	A	2.38095238	1	20	0.3690037	100	0.78595756	3.54
P1	1	20	A	2.38095238	1	20	0.3690037	100	0.78595756	3.54
Q1	1	20	A	2.38095238	2	40	0.7380074	200	1.571915121	4.69
R1	2	40	B	4.76190476	5	100	1.8450185	250	1.964893901	8.57
S1	2	40	B	4.76190476	6	120	2.2140221	300	2.357872681	9.33
T1	1	20	A	2.38095238	16	320	5.904059	1600	12.57532097	20.9
Total	42				271	5420		12723.33333		

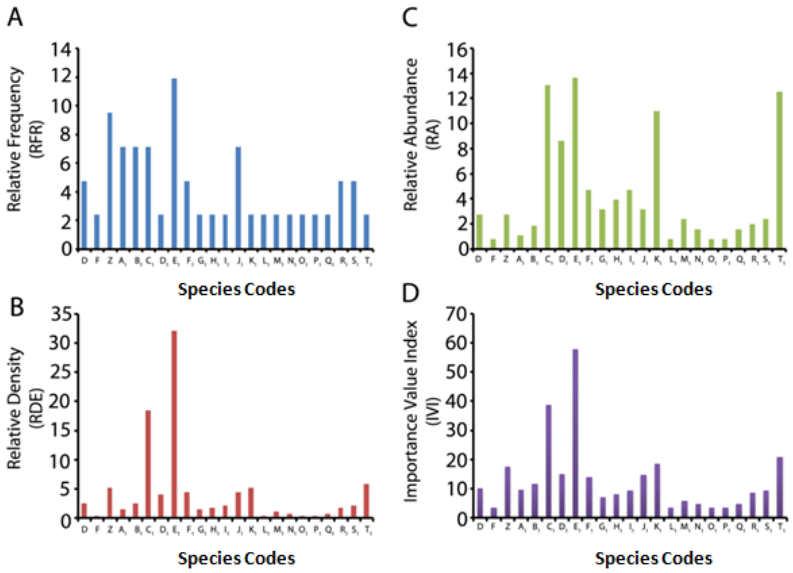

Figure 4: A) Relative Frequency, B) Relative Density, C) Relative Abundance and D) Importance value index of the community studied by quadrat sampling at Mudumalai.

Table 9: Calculation of diversity indices from the data obtained by quadrat study Mudumalai

Plant Code	***Scientific name***	***Family***	**Total Number (n)**	***n(n-1)***	***pi=n/N***	***ln(pi)***	***pi*ln(pi)***
D	*Cassia tora*	*Fabaceae*	7	42	0.02583	-3.65620867	-0.09444
F	*Parthenium hysterphorus*	*Asteraceae*	1	0	0.00369	-5.60211882	-0.02067
Z	*UIS-7*	*X*	14	182	0.051661	-2.96306149	-0.15307
A1	*Sonchus asper*	*Asteraceae*	4	12	0.01476	-4.21582446	-0.06223
B1	*Leucas procumbens*	*Lamiaceae*	7	42	0.02583	-3.65620867	-0.09444
C1	*UIS-8*	*X*	50	2450	0.184502	-1.69009582	-0.31183
D1	*Plectranthus incanus*	*Lamiaceae*	11	110	0.04059	-3.20422355	-0.13006
E1	*Eupatorium odoratum*	*Asteraceae*	87	7482	0.321033	-1.1362107	-0.36476
F1	*Eclipta alba*	*Asteraceae*	12	132	0.04428	-3.11721217	-0.13803
G1	*Oplismenus burmanii*	*Poaceae*	4	12	0.01476	-4.21582446	-0.06223
H1	*Cryptolepis buchanani*	*Apocynaceae*	5	20	0.01845	-3.99268091	-0.07367
I1	*Leucas mollissima*	*Lamiaceae*	6	30	0.02214	-3.81035935	-0.08436
J1	*Ficus hispida*	*Moraceae*	12	132	0.04428	-3.11721217	-0.13803
K1	*Solanum sp.*	*Solanaceae*	14	182	0.051661	-2.96306149	-0.15307
L1	*UIS-9*	*X*	1	0	0.00369	-5.60211882	-0.02067
M1	*UIS-10*	*X*	3	6	0.01107	-4.50350653	-0.04985
N1	*Aeschynomene indica*	*Fabaceae*	2	2	0.00738	-4.90897164	-0.03623
O1	*Leonurus sibiricus*	*Lamiaceae*	1	0	0.00369	-5.60211882	-0.02067
P1	*UIS-11*	*X*	1	0	0.00369	-5.60211882	-0.02067
Q1	*UIS-12*	*X*	2	2	0.00738	-4.90897164	-0.03623
R1	*Dodonaea viscosa*	*Sapindaceae*	5	20	0.01845	-3.99268091	-0.07367
S1	*UIS-13*	*x*	6	30	0.02214	-3.81035935	-0.08436
T1	*UIS-14*	*x*	16	240	0.059041	-2.8295301	-0.16706
Total (N)			271	11128		**Total**	-2.3903
		N(N-1)	73170				

Calculation of Diversity Indices-

Simpson's Index= $D = \frac{\Sigma\, n(n-1)}{N(N-1)}$ =0.15208419

Simpson's Diversity Index= 1-D = 0.84791581

Shannon Wiener Diversity Index (H) = -Σpi.ln (pi) =2.3903

Hmax=ln (number of species) = 3.13549422

Evenness= H/Hmax= 0.76233596

Analysis of Community Similarity

Community similarity among the three study sites were calculated by Sorenson's co-efficient, using the following formula:-

Sorenson's Coefficient= 2C/(S1+S2)

[C= Common species between two sites; S1= Number of species at site 1; S2= Number of species at site 2]

Sorenson's Coefficient between Bandipur study site 1 and Bandipur study site 2: -

= (2 x 8) / (17+16) = 0.48

[Number of common species= 8; Number of Species at Bandipur study site 1= 17; Number of Species at Bandipur study site 2= 16]

Sorenson's Coefficient between Bandipur study site 1 and Mudumalai: -

= (2 x 2) / (17+23) = 0.1

[Number of common species= 2;

Number of Species at Bandipur study site 1= 17;

Number of Species at Mudumalai= 23]

Sorenson's Coefficient between Bandipur study site 2 and Mudumalai: -

= (2 x 0) / (16+23) = 0

[Number of common species= 0;

Number of Species at Bandipur study site 2= 16;

Number of Species at Mudumalai= 23]

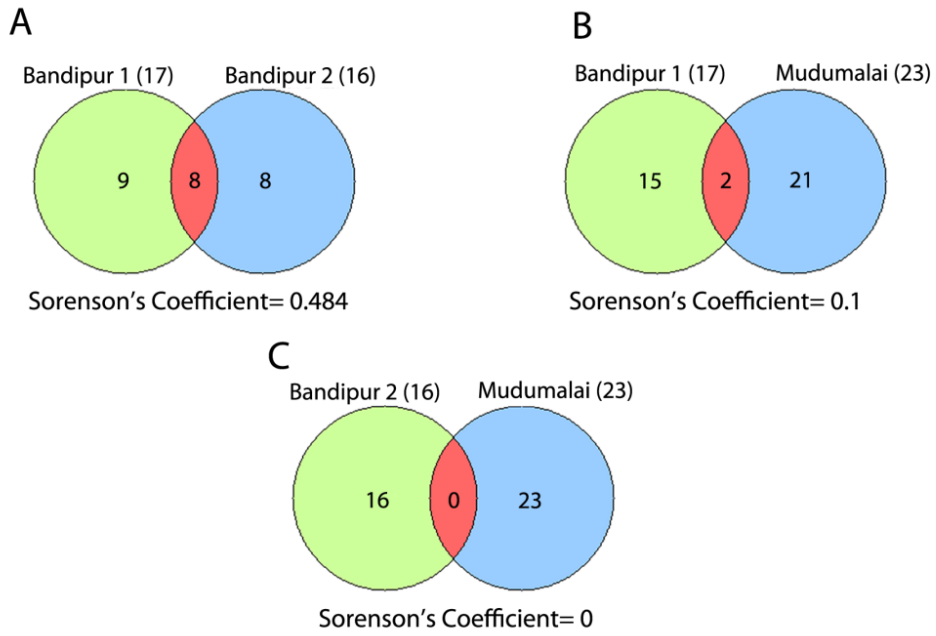

Figure 5: Venn diagrams showing Community Similarity between A) Bandipur site 1 and 2, B) Bandipur site 1 and Mudumalai, C) Bandipur site 2 and Mudumalai.

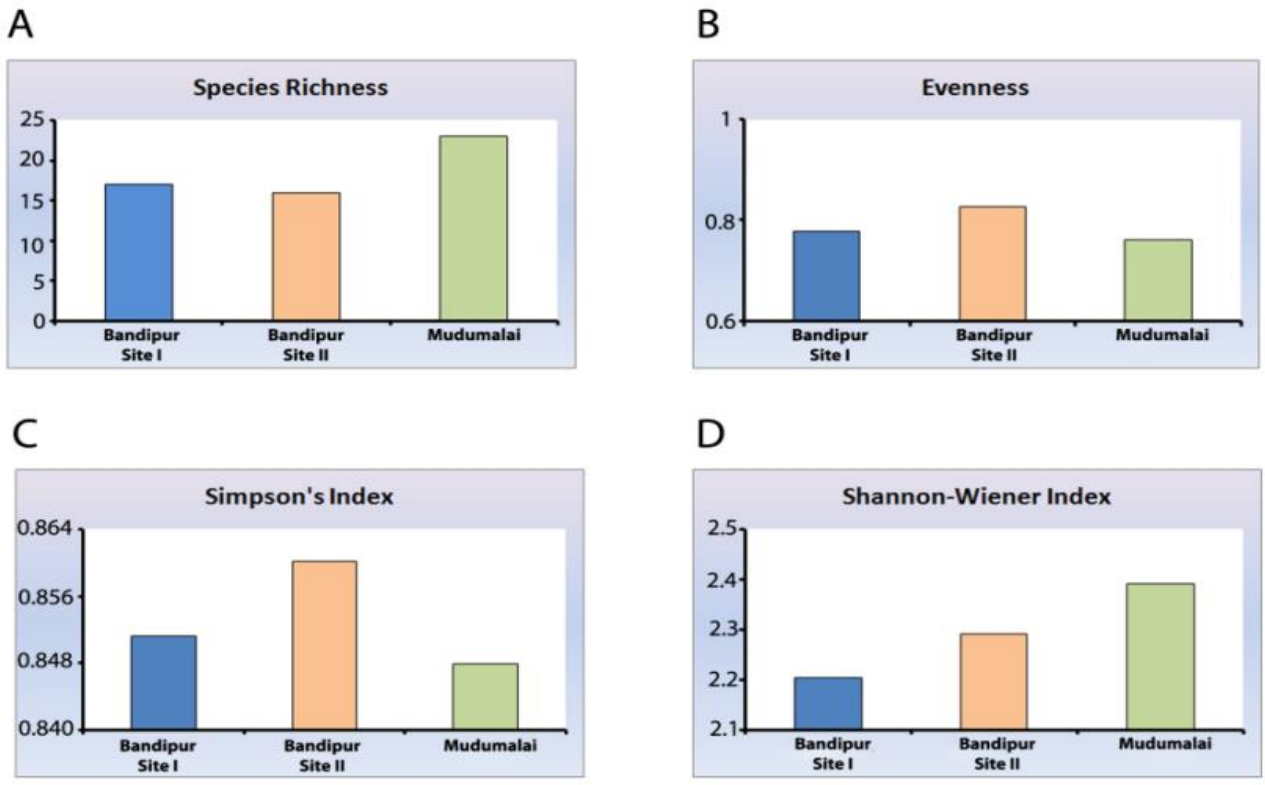

Figure 6: A) Species Richness, B) Evenness, C) Simpson's Index and D) Shannon-Wiener Index in the three study sites of Nilgiri Biosphere Reserve.

Soil Texture Analysis

Soil texture, an inherent soil property effects several other related properties, which again influence overall agricultural potential. In particular soil texture influences nutrient retention, productivity, water storage and drainage [4]. Soils with a higher proportion of sand retain less nutrients and water compared to clay soils. Our study indicated greater sand content in the sample collected from Bandipur compared to the sample collected from Mudumalai. This implies that the soil of Bandipur has lower water and nutrient retention capacity and hence it is less productive than Mudumalai.

Pitfall Analysis

The results of pitfall analysis also showed similar trends. Among the collected micro-arthropodes, *Pheidole* sp. was the dominat species at Bandipur. On the other hand, almost equal numbers of individuals were recorded for three different species viz., *Myrmicaria* sp., *Lophomyrmex* sp. and *Pheidologeton* sp. at Mudumalai, which again denotes high species evenness at this forest.

Table 10: List of Soil-microarthropods collected from Pitfall traps at Bandipur.

Grass Surface					
Species Code	COMMON Name	Scientific Name	Order	Family	Number of individuals
A	Diacamma	*Diacamma sp.*	Hymenoptera	Formicidae	10
B	Common godzilla ant	*Camponotus compressus*	Hymenoptera	Formicidae	8
C	Pheidole	*Pheidole sp. 1*	Hymenoptera	Formicidae	32
D	Chalcid Wasp	*SNI*	Hymenoptera	Chalcididae	2
E	Tachinid Fly	*SNI*	Diptera	Tachinidae	1
F	Lophomyrmex	*Lophomyrmex quadrispinosus*	Hymenoptera	Formicidae	17
G	Ground Spider	*SNI-1*	Araneae	Gnaphosidae	1
H	Phorid Fly	*SNI-1*	Diptera	Phoridae	1
				Total	72

Nude Soil Surface					
Species Code	COMMON Name	Scientific Name	Order	Family	Number of individuals
I	Springtail	*SNI-1*	Collembola	x	110
J	Springtail	*SNI-2*	Collembola	x	75
K	Ground Beetle Larvae	*SNI*	Coleoptera	Carabidae	1
				Total	186

Figure 7: Photographs of some samples collected in pitfall traps in Bandipur under bright field microscope A) *Diacamma* sp., B) *Camponotus compressus*, C) *Lophomyrmex quadrispinosus*, D) *Pheidole* sp., E) Pheidole Soldier, F) *Springtail* sp. 1 (Above) and 2 (Below) [Scale not given].

Table 11: List of Soil-microarthropods collected from Pitfall traps at Mudumalai.

Grass Surface					
Species Code	COMMON Name	Scientific Name	Order	Family	Number of individuals
A	Diacamma	*Diacamma sp.*	Hymenoptera	Formicidae	5
C	Pheidole	*Pheidole sp. 1*	Hymenoptera	Formicidae	12
D	East Indian harvesting ant	*Pheidologeton sp.*	Hymenoptera	Formicidae	7
L	Myrmicaria	*Myrmicaria brunnea*	Hymenoptera	Formicidae	58
M	Brachyponera	*Brachyponera lutipes*	Hymenoptera	Formicidae	12
N	Assasin bug nymph	*SNI 8*	Hemiptera	Reduviidae	2
O	Wasp	*SNI 9*	Hymenoptera	Mutillidae	2
					98

Nude Soil Surface					
Species Code	COMMON Name	Scientific Name	Order	Family	Number of individuals
J	Springtail	*SNI 2*	Collembola	x	212
P	Woodroach nymph	*SNI 10*	Blattodea	X	3
				Total	215

Figure 8: Photographs of some samples collected in pitfall traps in Mudumalai under bright field microscope A) *Pheidologeton* sp., B) *Myrmicaria* sp., C) Assasin Bug nymph, D) Woodroach nymph [Scale not given].

Canopy cover study

Random sampling revealed significantly high average canopy cover at Mudumalai in comparison to Bandipur. However, Canopy closure could not be measured due to lack of equipments.

Analysis of the Zooplankton Community

Analysis of the zooplankton community in one water body each at Bandipur and Mudumalai also gave similar trends. At Bandipur, only two species were recorded viz., *Daphnia* sp. and *Paracyclops* sp. On the other hand, thirteen different species were recorded at Mudumalai among which *Paracyclops* sp. was dominant. However, statistical analysis could not be performed due to low number of sampling units.

Survey on Eco-sensitive Zone

Finally, the survey work revealed the possible causes behind the aforementioned differences between the two forests located in the same biosphere reserve.

At Bandipur, lots of small hotels have been constructed at close vicinity of the forest. While at Mudumalai, the numbers are far less. This has resulted in lesser habitat destruction, as well as lesser production of non-biodegradable waste products at the forest of Mudumalai.

Erection of electrical fence is totally prohibited at Mudumalai. However, at Bandipur, a number of wild animals die yearly being electrocuted in the fences.

Besides this, poisoned food used by poachers also plays a significant role to the increase of the death toll of wild animals at Bandipur. Very recently though, strict measures are being taken to mitigate these problems, after Bandipur was demarcated as an Eco Sensitive Zone by Ministry of Environment and Forests, Govt. of India in 2012 [8].

Habitat destruction at Bandipur has led towards a conflict between local residents and wild animals, chiefly elephants. Often, elephants have been reported to enter human establishments and cause damage.

To counter this problem, local residents had to take extreme measures in order to drive them away. Unfortunately, this has resulted in quite a few elephant deaths over the past years, either knowingly or unknowingly. Very recently, a tiger was found dead in a waterbody at Bandipur. It was suspected that the locals might have placed poisoned bait.

On the contrary, an eco-friendly measure taken at Mudumalai prevented this conflict. An Elephant camp has been set up at Theppakkadu village where local tribal people look after the elephants. In this camp, injured and pregnant elephants are looked after and treated. Besides this, abandoned baby elephants are raised. Setting up this camp has increased public awareness about this species. This is a beautiful example how proper forest management measures can lead to co-existence of wild animal and local residents who otherwise could have been turned into enemies.

4. CONCLUSION

Like any other system, the ecosystem also depends on integration of all of its components to run properly. If even a single component is lost, the whole system becomes destabilized. The observation of the present study confirms this fact.

In a nutshell, the present study demonstrated how differences in forest management standards can cause drastically different consequences in two adjacent forests located within the same biosphere reserve.

Actually, the study was part a short field trip and can be regarded very usefully as a model study. Further extension of the study will lead towards unravelling more facets in this story.

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