The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	**Sachin Vijay Chorge**
Project title	To study the population dynamics of 'Scarabaeid beetles' and to promote use of agriculturally beneficial species in Kudal region of Sindhudurg, Maharashtra
RSG reference	18347-2
Reporting period	March 2016 – April 2017
Amount of grant	GBP 5000/-
Your email address	sachinvch@gmail.com
Date of this report	2-5-2017

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Population dynamics and dependent factors				
study of distribution of Scarabaeid beetles				
Study on Grub compost				
The hands on training workshop for farmers				
The awareness amongst people				
The correlation between the Habitats and Scarabaeid beetle				

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

No major unforeseen difficulties were faced on field due to on-field experiences during 1st phase. But difficulties in taxonomic work were felt which lead to 2 month extension of the project. I would plan for good amount of time for post field work in next phase of the project.

3. Briefly describe the three most important outcomes of your project.

A. Knowledge about Population dynamics of Scarabaeid beetles

In the current study, in 10 sites distributed over an area covering 635 km^2, 26 species were sampled belonged to Scarabaeinae (13 species), Rutelinae (4 species), Cetoniinae (4 species), Melolonthinae (3 species) and Dynastinae (2 species) (Table 1). The sites were Digas (R1) 16° 4'26.16"N 73°43'26.00"E, Hirlok (R2) 16° 4'13.52"N 73°46'6.16"E, Narur(R3) 16°2'43.44"N 73°51'43.02"E, Bambarde (R4) 16°3'31.66 "N 73°45'33.50"E, Nerur(R5) 16° 1'18.17"N 73°36'40.55"E, Pavshi (R6) 16° 1'25.72"N 73°41'58.13"E, Bav (R7) 16° 3'22.59"N 73°40'54.07"E, Anav(R8) 16° 5'13.91"N 73°41'42.33"E, Pangrad (R9) 16° 16° 8'32.10"N 73°49'40.19"E and Ghodge (R10) 16°10'14.15"N 73°52'47.21"E. Figure1.

Figure 1. Location of Study Sites

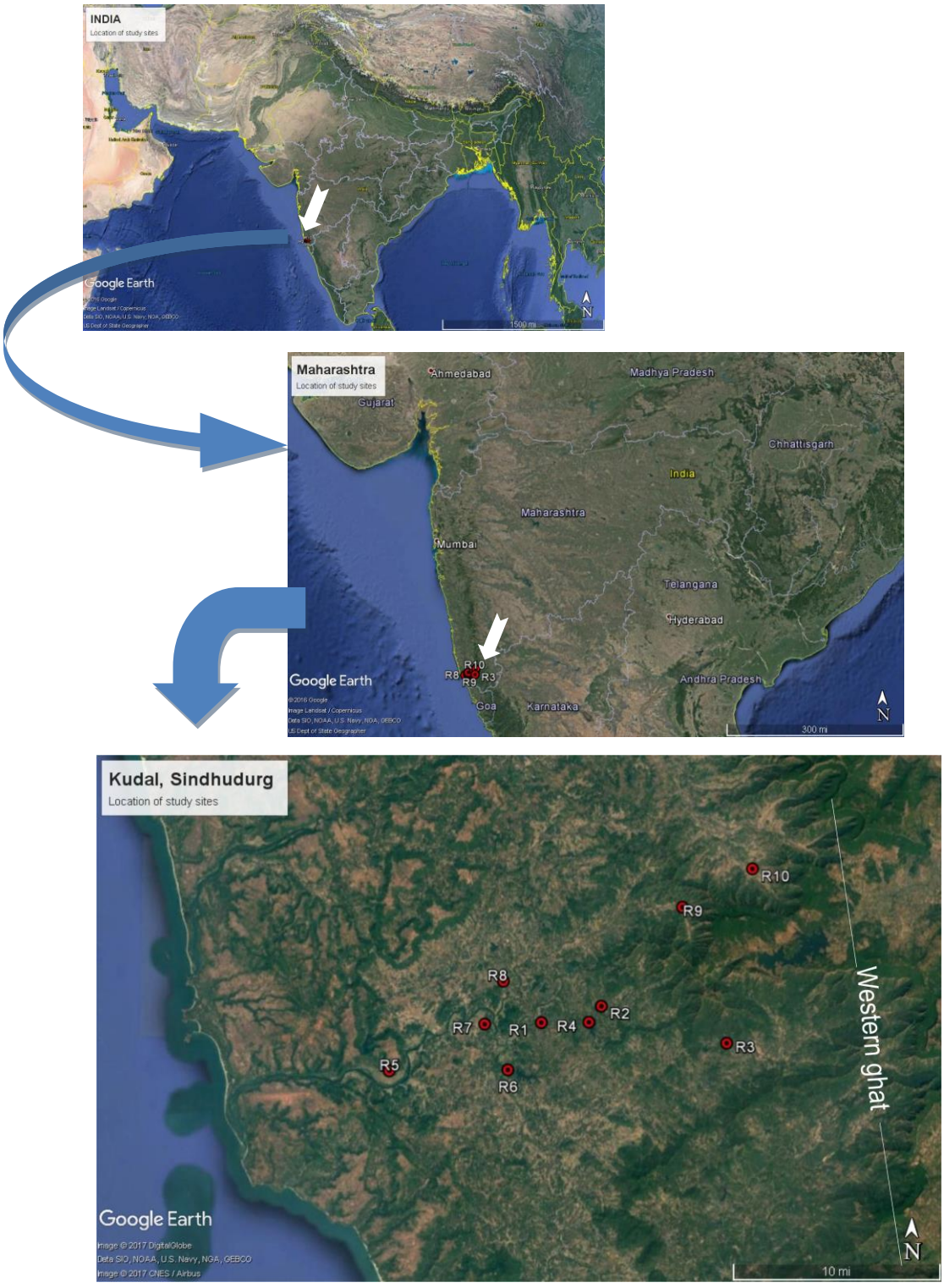


Table 1. List of Scarabaeid beetle species

Sr. Code	Species Name	Sr. Code	Species Name
	Sub family: Scarabaeinae		**Subfamily: Rutelinae**
	Tribe Coprini		**Tribe: Anomalini**
1	*Copris davisoni* Waterhouse		**Subtribe: Anomalina**
2	*Copris signatus* Walker	14	*Anomala bengalensis* Blanchard
3	*Copris repertus* Walker	15	*Anomala chloropus* Arrow
4	*Onitis subopacus* Arrow	16	*Anomala marginipennis* Arrow
5	*Helicopris bucephalus*	17	*Anomala comma* Arrow
6	*Catharsius molossus* Linnaeus		**Subfamily: Cetoniinae**
	Sub family: Scarabaeinae		**Tribe: Cetoniini**
	Tribe: Onthophagini		**Subtribe: Cetoniina**
7	*Onthophagus catta* Arrow	18	*Chiloloba acuta* G. & P.
8	*Onthophagus dama* Fabricius	19	*Clinteria klugi* Hope
9	*Onthophagus cervus* Fabricius	20	*Oxycetonia versicolor* Fabricius
10	*Onthophagus spinifex* Fabricius	21	*Heterorrhina micans*
11	*Onthophagus unifasciatus* Schall.		
12	*Digitonthophagus gazella* Fabricius		**Subfamily: Melolonthinae**
	Sub family: Scarabaeinae	22	*Holotrichia seticollis* Moser
	Tribe:Sysiphini	23	*Sophrops sp.*
13	*Sysiphus longipes* Olivier	24	*Lepidiota albistigma* Burmeister
			Subfamily: Dynastinae
			Tribe: Dynastini
		25	*Xylotrupes gideon* Linnaeus
		26	*Oryctes rhinoceros* Linnaeus

The monthly consolidated data for all regions (Table 2) depicts that there was great variation in population as well as species number in different regions. Higher population and species number was observed during May to October (end of summer season to end of monsoon season).

Table 2. Monthly variation of dung beetle assemblages (Average for all regions)

Sr. code	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	SUM	AVG
1	0	0	80	56	49	11	20	14	10	1	19	10	270	23
2	0	0	44	25	19	11	21	10	10	0	0	0	140	12
3	0	0	38	10	15	0	14	1	0	0	0	0	78	7
4	0	0	114	66	44	47	10	5	0	0	0	0	286	24
5	0	0	17	11	1	6	0	0	0	0	0	0	35	3
6	0	0	26	15	10	9	0	0	0	0	0	0	60	5
7	0	0	41	24	20	10	0	10	0	6	4	0	115	10
8	0	0	36	20	19	9	10	10	0	0	0	0	104	9
9	0	0	32	40	10	6	10	4	0	0	4	0	106	9
10	0	0	43	15	0	0	0	5	0	6	5	5	79	7
11	0	0	97	74	47	10	14	10	0	0	3	0	255	21
12	0	0	61	26	20	10	0	5	6	0	0	0	128	11
13	0	0	2	7	1	0	0	0	0	0	0	0	10	1
14	13	16	98	64	69	20	15	10	20	20	10	10	365	30
15	26	0	75	57	40	20	50	10	0	10	10	10	308	26
16	8	0	92	104	58	10	29	10	9	9	10	0	339	28
17	0	32	96	78	65	63	37	24	0	10	0	0	405	34
18	0	0	0	0	17	0	26	68	0	0	0	0	111	9
19	0	0	0	0	0	4	13	23	4	0	0	0	44	4
20	0	0	0	0	0	0	15	4	5	3	3	0	30	3
21	0	0	0	27	19	8	5	0	0	0	0	0	59	5
22	0	0	95	81	86	49	20	19	0	0	0	0	350	29
23	0	0	67	63	68	9	9	9	9	9	0	0	243	20
24	0	0	46	25	15	10	0	0	3	0	0	0	99	8
25	0	0	14	27	10	0	0	0	0	0	0	0	51	4
26	15	31	50	48	10	40	14	15	14	4	10	33	284	24

N	**62**	**79**	**1264**	**963**	**712**	**362**	**332**	**266**	**90**	**78**	**78**	**68**	**435**	**363**
S	**4**	**3**	**22**	**23**	**23**	**20**	**18**	**20**	**10**	**10**	**10**	**5**	**26**	**26**
Scarabaeinae(s)	**0**	**0**	**13**	**13**	**12**	**10**	**7**	**10**	**3**	**3**	**5**	**2**		
Total(n)	**0**	**0**	**631**	**389**	**255**	**129**	**99**	**74**	**26**	**13**	**35**	**15**		
Coprini(s)	0	0	6	6	6	5	4	4	2	1	1	1		
Total(n)	0	0	319	183	138	84	65	30	20	1	19	10		
Onthophagini(s	0	0	6	6	5	5	3	6	1	2	4	1		
Total(n)	0	0	310	199	116	45	34	44	6	12	16	5		
Sysiphini(s)	0	0	1	1	1	0	0	0	0	0	0	0		
Total(n)	0	0	2	7	1	0	0	0	0	0	0	0		
Rutelinae(s)	**3**	**2**	**4**	**4**	**4**	**4**	**4**	**4**	**2**	**4**	**3**	**2**		
Total(n)	**47**	**48**	**361**	**303**	**232**	**113**	**131**	**54**	**29**	**49**	**30**	**20**		
Citoniinae(s)	**0**	**0**	**0**	**1**	**2**	**2**	**4**	**3**	**2**	**1**	**1**	**0**		
Total(n)	**0**	**0**	**0**	**27**	**36**	**12**	**59**	**95**	**9**	**3**	**3**	**0**		
Melolonthinae	**0**	**0**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**0**	**0**		
Total(n)	**0**	**0**	**208**	**169**	**169**	**68**	**29**	**28**	**12**	**9**	**0**	**0**		
Dynastynae(s)	**1**	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**		
Total(n)	**15**	**31**	**64**	**75**	**20**	**40**	**14**	**15**	**14**	**4**	**10**	**33**		

From May to August Scarabaienae were predominant, especially species of tribes Coprini and Onthophagini. The sites R1, R7 and R9 were equally dominated by Scarabainae and Rutelinae (Graph 1). From September Rutelinae dominated the species composition. January onwards till April Rutelinae was the dominant tribe in the species composition. Dynastinae were found present throughout the year in low numbers during summer season and in increased numbers during May and June. The beetles of subfamily Melolonthinae were active during May to December afterwards their activity gradually decreased from May to December. Cetoniinae was found active from June and their activity gradually increased in October. Thereafter their activity suddenly decreased. From a bio-geographical point of view, the fauna observed at this regional scale was apparently the same everywhere.

Measurement of diversity:

The diversity index was calculated by using the Shannon – Wiener diversity index (1949).

Diversity index = $H = -\sum H\ Pi\ ln\ Pi$,

where, $Pi = S / N$, S = number of individuals of one species,

N = total number of all individuals in the sample and

ln = logarithm to base e.

For the measurement of species richness (a-diversity), Margalef's index was used as a simple measure of species richness (Margalef, 1958).

Margalef's index (Dm) = $(S - 1) / ln\ N$,

where, S = total number of species,

N = total number of individuals in the sample and

ln = natural logarithm.

Comparison between diversity of different sites (β diversity)

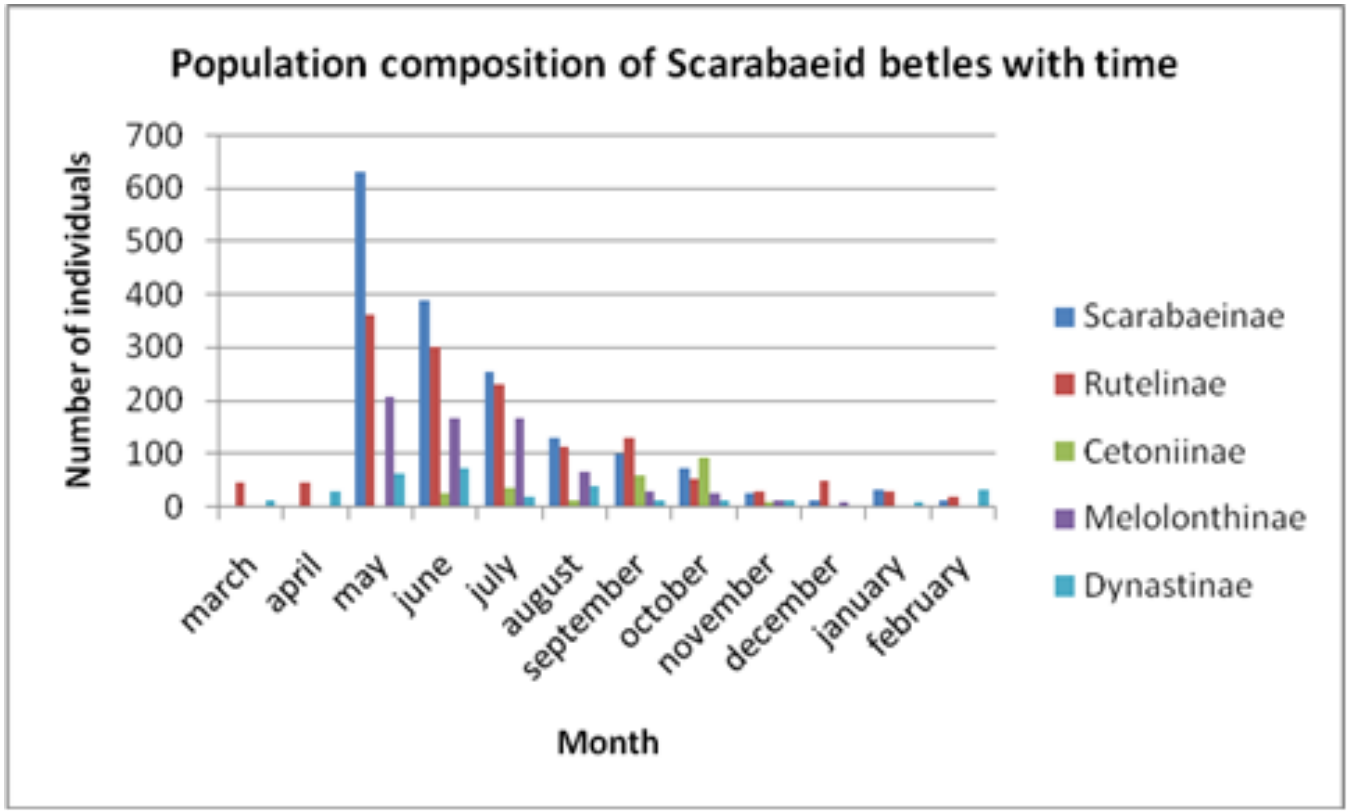
Whittekar index (βw) = $(S/S')-1$,

Where, S = total number of species throughout the regions,

S'= total number of species in the target region.

Analysis of Variance (ANNOVA) was calculated using existing Microsoft excel statistic software.

Graph 1



The Margalef index (Dm) for a diversity was calculated for every region over study period (Table 3). There was significant increase in diversity during May to October. Also significant variation in diversity was seen amongst regions ($F=2.366 > Fcrit=1.976$, $df=9$, $P\text{-value}=0.018 < p=0.05$).

Table 3 Diversity of dung beetle assemblages in sites (Margalef Index for alpha diversity) Dm

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Variance with
R1	2.164	1.243	3.812	4.434	4.414	4.039	3.822	4.498	2.404	2.569	2.232	1.864	1.340
R2	1.365	0.962	4.268	4.854	4.677	5.083	4.708	4.821	3.336	3.186	3.753	1.924	2.102
R3	-	0.869	4.138	4.628	4.834	4.744	4.782	5.063	3.186	2.885	3.909	1.924	2.846
R4	1.303	0.962	4.192	4.678	4.551	5.023	4.617	4.248	3.186	2.885	2.569	1.542	2.102
R5	1.170	0.910	4.280	4.702	4.905	5.104	4.500	5.102	3.186	2.885	2.885	1.674	2.405
R6	1.251	1.028	4.050	4.539	4.774	4.368	4.659	4.206	2.569	2.232	2.232	1.674	2.050
R7	1.674	1.028	4.163	4.512	4.591	4.951	4.368	4.660	3.186	3.186	2.569	2.056	1.760
R8	1.443	0.962	4.223	4.590	4.692	4.913	4.821	4.660	3.040	2.885	2.569	2.056	2.030
R9	1.443	1.028	4.149	4.531	4.757	4.659	4.905	4.465	3.186	2.569	2.232	1.674	2.098
R10	1.443	0.869	3.922	4.560	4.757	4.847	4.219	4.752	2.731	2.885	3.474	1.924	1.925

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	2.084	9.000	0.232	2.366	0.018	1.976

When the a- diversities of abundance season (May to October) were compared (Table 4) it was observed that there was significant variation in regions; but the variation over time could not be compared due to P-value<<p. The higher P-value was obtained when a- diversities of June to October were compared (P-value=0.169 > p=0.05), also F < Fcrit indicates that there was no significant difference in diversities during June to October (Table 5).

Table 4. Diversity of dung beetle assemblages in sites (Alpha diversity Dm) from May to October

	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	***Variance according to time***
R1	3.8125	4.433745	4.414431	4.039238	3.822183	4.497691	0.100514
R2	4.268309	4.853727	4.67654	5.083381	4.707944	4.820834	0.072957
R3	4.137789	4.628081	4.834471	4.74394	4.781529	5.062795	0.095902
R4	4.19227	4.678481	4.551196	5.022996	4.616624	4.247783	0.092793
R5	4.280063	4.702291	4.904921	5.104413	4.500263	5.101728	0.111469
R6	4.050009	4.538524	4.773663	4.3681	4.659307	4.205701	0.076192
R7	4.163179	4.512286	4.590621	4.950513	4.3681	4.660012	0.071559
R8	4.222796	4.590454	4.691884	4.913252	4.820834	4.660012	0.057278
R9	4.149135	4.531009	4.75659	4.659307	4.905163	4.465006	0.068888
R10	3.922227	4.560092	4.75659	4.847085	4.218996	4.751587	0.133093
Variance according to site	0.022778	0.01414	0.020882	0.115718	0.107588	0.092299	

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	1.630088	9	0.181121	4.709709	0.000198	2.095755
Columns	2.672663	5	0.534533	13.89952	3.21×10^{-08}	2.422085

Table 5. Diversity of dung beetle assemblages in sites (Alpha diversity Dm) from June to October

	Jun	**Jul**	**Aug**	**Sep**	**Oct**	***Variance***
R1	4.433745	4.414431	4.039238	3.822183	4.497691	**0.087308**
R2	4.853727	4.67654	5.083381	4.707944	4.820834	**0.025821**
R3	4.628081	4.834471	4.74394	4.781529	5.062795	**0.025693**
R4	4.678481	4.551196	5.022996	4.616624	4.247783	**0.077264**
R5	4.702291	4.904921	5.104413	4.500263	5.101728	**0.068608**
R6	4.538524	4.773663	4.3681	4.659307	4.205701	**0.051338**
R7	4.512286	4.590621	4.950513	4.3681	4.660012	**0.046673**
R8	4.590454	4.691884	4.913252	4.820834	4.660012	**0.016879**
R9	4.531009	4.75659	4.659307	4.905163	4.465006	**0.03101**
R10	4.560092	4.75659	4.847085	4.218996	4.751587	**0.062924**
Variance	**0.01414**	**0.020882**	**0.115718**	**0.107588**	**0.092299**	

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	1.496664	9	0.166296	3.608638	0.002731	2.152607
Columns	0.3151	4	0.078775	1.709423	0.169293	2.633532

Table 6. Diversity indices indicating diversity of Scarabaeid beetles in different regions.

Region	Shannon Wiener Index (H)	Simpson Diversity Index (1-D)	Margalef Index a Diversity (Dm) max*(overall)**	Whittaker Index β Diversity (βw) min*(overall)**
R1	2.826	0.929	4.433 (3.950)	0.238 (0)
R2	3.166	0.931	4.853 (4.061)	0.130 (0)
R3	3.412	0.930	4.628 (4.016)	0.130 (0)
R4	2.971	0.942	4.678 (3.954)	0.181 (0.040)
R5	2.841	0.950	4.702 (4.001)	0.181 (0.040)
R6	2.686	0.951	4.538 (4.033)	0.238 (0.040)
R7	2.932	0.935	4.512 (3.782)	0.181 (0.083)
R8	2.955	0.946	4.590(3.967)	0.181(0.04)
R9	2.863	0.942	4.531(3.978)	0.181(0.04)
R10	2.990	0.935	4.560(3.770)	0.181(0.04)

Max* and Min* the values obtained for month with higher abundance.
Overall** the values obtained after calculating average for every region.

In the Table 6 different indices of diversity for consolidated yearly data was compared. The Shanon index was high for R3>R2>R10>R4 indicating greater diversity whereas lower value was obtained for H(R1)=2.826. The Simpson index of species diversity and evenness depicts that the species distribution was fairly even throughout the regions. Margalef index (Dm) for a-diversity indicate that for R2>R5>R4 showed higher diversity within region during abundance season. The comparison between overall a-diversities indicated that R2>R6>R3>R5 have higher diversity within region. When these data was compared to obtain β-diversity (βw), the region R2 and R3 were consistent with other indices and the lower value indicated higher diversity during abundance season. That indicates there is higher probability of getting different species within fewer samples.

B. Knowledge about distribution and relation with habitat

The four types of habitat types were seen in the study area. The region R1 represents habitat with agricultural land and thin patches of tall vegetation (AT). In this area deforestation occurred leaving behind very tiny areas with remnants of original forest. Region R2 and R3 represented habitats with less disturbed dense forest with patches of agricultural land (AD). R4, R5, R7 and R9 includes habitat with moderate forest (AM), which could be considered as result of woodcutting activity in dense forest. The habitat with scrub forest (AS) in which deforested and under continuous anthropogenic pressure and agricultural land are seen in R10 region. The average population with respect to habitats is shown in table 7. The scrub and the dense forest regions showed higher diversity (Dm). Here more diversity studies of AS habitat are recommended, as only one site was considered with such habitat which might have given higher values of diversity. Therefore the dense forest area harbour larger species density. The species distribution and population composition among the habitats varied significantly ($F=5.701 > Fcrit=2.726$, $df=3$ and P-value $=0.001 < p=0.05$).

Table 7. Diversity of dung beetle assemblages amongst habitats

		Habitat			
Sr. code	**Species Name**	**AT**	**AD**	**AM**	**AS**
1	*Copris davisoni* Waterhouse	56	57	71	57
2	*Copris signatus* Walker	25	29	46	27
3	*Copris repertus* Walker	10	22	21	18
4	*Onitis subopacus* Arrow	63	61	84	61
5	*Helicopris bucephalus* Fabricius	3	14	7	7
6	*Catharsius molossus* Linnaeus	10	17	16	12
7	*Onthophagus catta* Arrow	20	27	33	24
8	*Onthophagus dama* Fabricius	20	24	30	20
9	*Onthophagus cervus* Fabricius	16	26	31	23
10	*Onthophagus spinifex* Fabricius	11	22	19	19
11	*Onthophagus unifasciatus* Schall.	46	57	67	60

12	*Digitonthophagus gazella* Fabricius	24	29	35	28
13	*Sysiphus longipes* Olivier	0	6	0	4
14	*Anomala bengalensis* Blanchard	69	67	116	77
15	*Anomala chloropus* Arrow	70	60	93	53
16	*Anomala marginipennis* Arrow	75	66	100	56
17	*Anomala comma* Arrow	76	93	107	84
18	*Chiloloba acuta* G. & P.	15	28	34	23
19	*Clinteria klugi* Hope	4	15	14	11
20	*Oxycetonia versicolor* Fabricius	3	9	11	4
21	*Heterorrhina micans Guérin Méneville*	6	15	19	13
22	*Holotrichia seticollis* Moser	70	67	99	72
23	*Sophrops sp.*	62	51	78	25
24	*Lepidiota albistigma* Burmeister	13	23	30	22
25	*Xylotrupes gideon* Linnaeus	6	12	16	12
26	*Oryctes rhinoceros* Linnaeus	46	79	75	58
	N (Number of Individuals)	**409**	**488**	**417**	**435**
	S (Number of Species	25	26	25	26
	Dm (Margalef index- a diversity)	3.990067	4.038566	3.977537	**4.114992**
	H (Shonnon-Wiener index)	2.87974	**3.05363**	2.9820	3.00293

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Rows	15022.17	25	600.8867	71.31924	1.76E-42	1.653206
Columns	144.1226	3	48.04087	5.70197	0.001429	2.726589
Error	631.8982	75	8.42531			

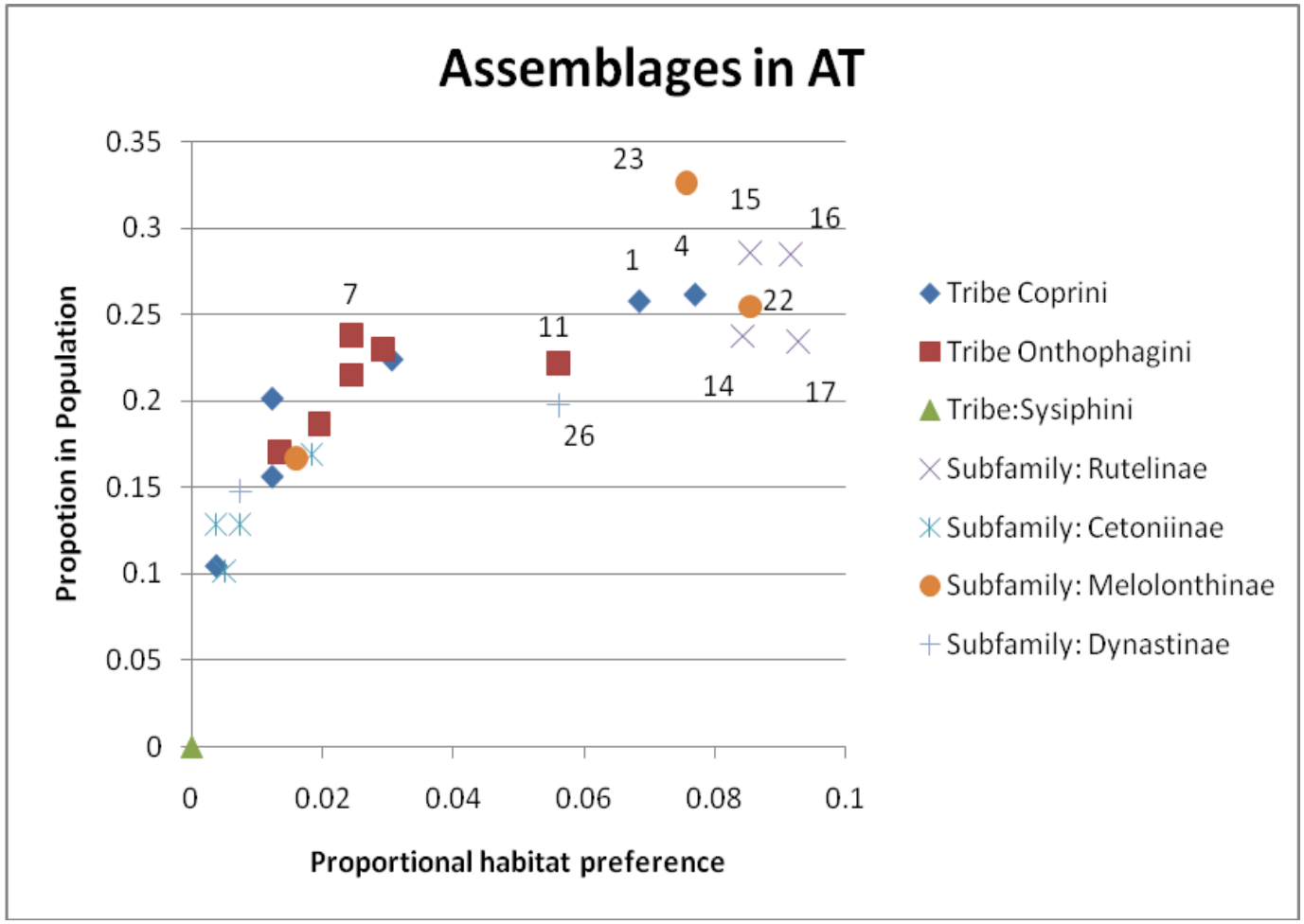
Total	15798.19	103

The graphs plotted using proportion in population for each species against proportional habitat preference indicates that in habitats where agricultural lands surrounded by small patches of tall trees (AT) (graph 2) showed dominance of family Melolonthinae (*Sophrops* sp. and *Holotrichia seticollis)*. From subfamily Rutelinae *Anomella* sp. were dominant in this region. *Copris davisoni* and *Onitis subopacus* from Scarabaeinae were seen dominant in this region whereas *Onthophagus unifasciatus* and *Oryctes rhinoceros* of subfamily Scarabaeinae and Dynastinae respectively found equally dominant in this region.
In the agricultural zones surrounded by dense forest (AD) it was observed that Scarabaeinae was found more dominant specially *Sysiphus longipes* and *Helicopris bucephalus* (graph 3). Cetoniinae was found second dominant family in this region. Other species were found occupying the habitat in more or less similar proportion.

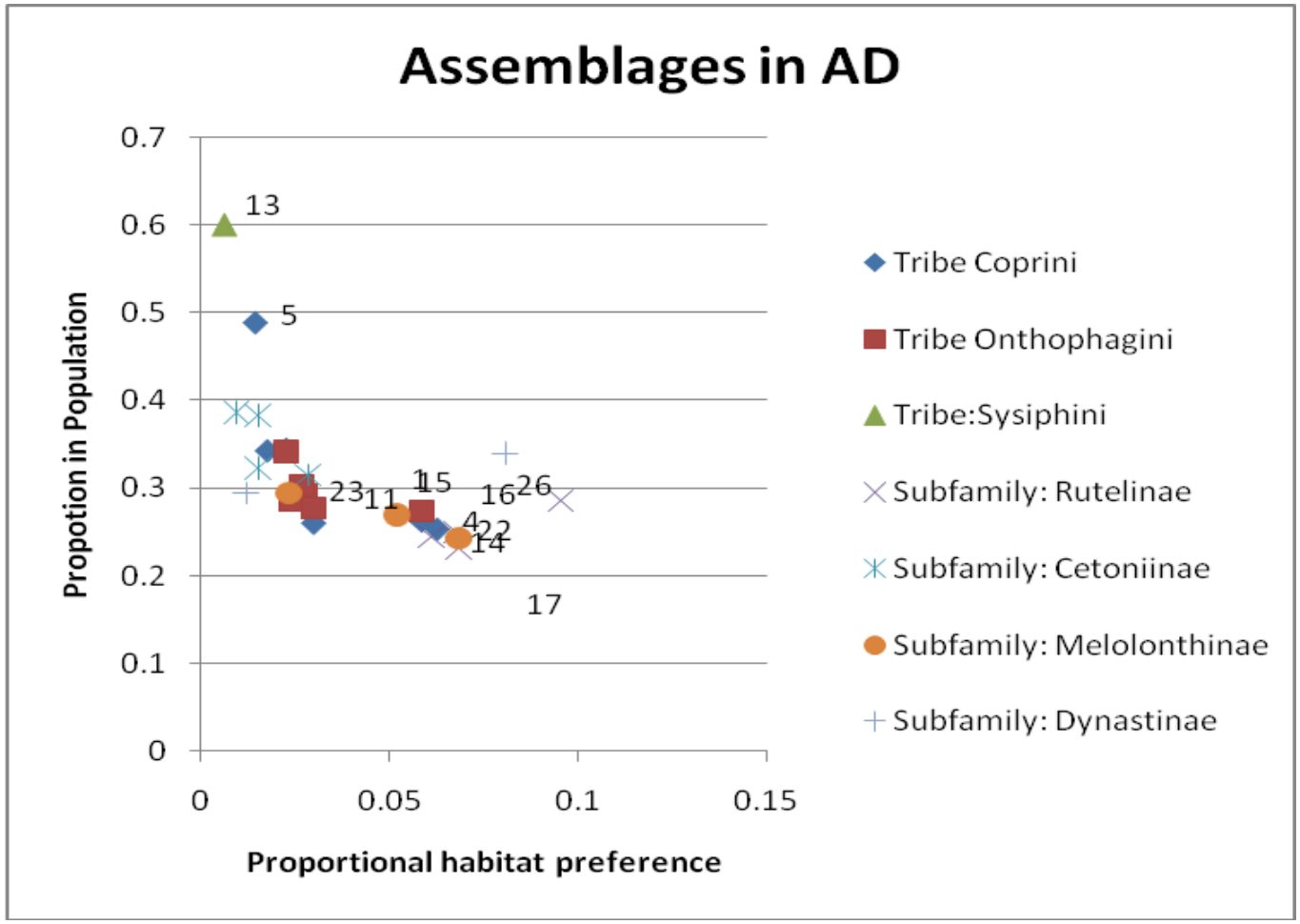
In the region where agriculture lands were surrounded by moderate forest (AM), Cetoniinae beetles specially *Oxycetonia versicolor* and *Heterorrhina micans* were predominant (graph 4). *Copris signatus* of Scarabaeinae and *Anomala* sp. were second dominant group of beetles in this region. Other species showed moderate population composition.

In the region where agricultural land was surrounded by scrub forest, the beetles of family Scarabaeinae and Dynastinae were dominant. The dominant species mainly includes *Onthophagus* sp. and *Sysiphus longipes* (graph 5).

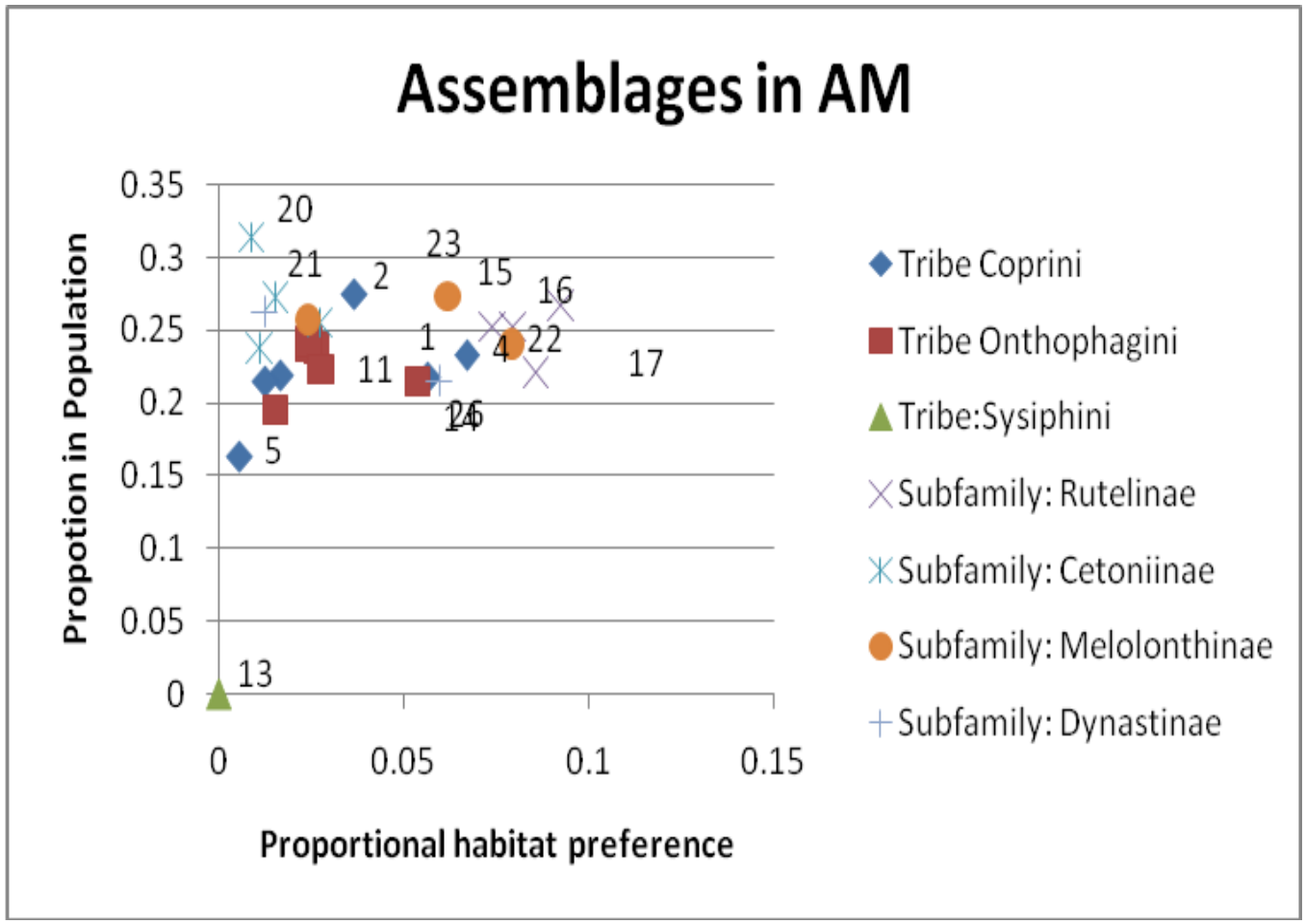
Graph 2


Assemblages in AT
Propotion in Population
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.02
0.04
0.06
0.08
0.1
Proportional habitat preference
23
15
16
4
1
7
22
11
14
17
26
Tribe Coprini
Tribe Onthophagini
Tribe:Sysiphini
Subfamily: Rutelinae
Subfamily: Cetoniinae
Subfamily: Melolonthinae
Subfamily: Dynastinae

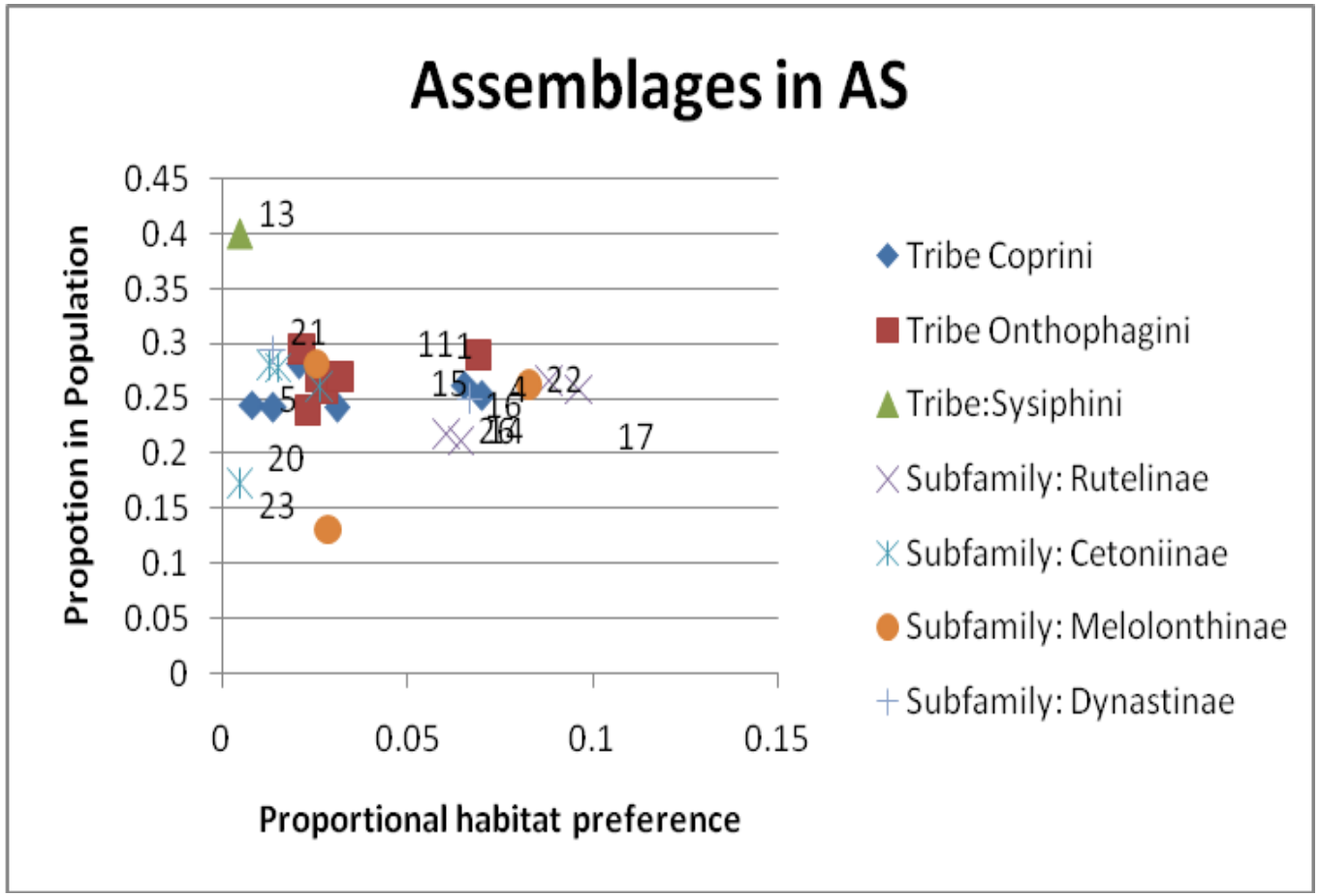
Graph 3


Assemblages in AD
Propotion in Population
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.05
0.1
0.15
Proportional habitat preference
13
5
23
11
15
16
26
4
22
14
17
Tribe Coprini
Tribe Onthophagini
Tribe:Sysiphini
Subfamily: Rutelinae
Subfamily: Cetoniinae
Subfamily: Melolonthinae
Subfamily: Dynastinae

Graph 4


Assemblages in AM
Propotion in Population
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
Proportional habitat preference
20
21
2
23
15
16
1
4
22
17
11
5
13
Tribe Coprini
Tribe Onthophagini
Tribe:Sysiphini
Subfamily: Rutelinae
Subfamily: Cetoniinae
Subfamily: Melolonthinae
Subfamily: Dynastinae

Graph 5


Assemblages in AS
Propotion in Population
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
Proportional habitat preference
13
21
111
15
4
22
5
16
17
20
23
Tribe Coprini
Tribe Onthophagini
Tribe:Sysiphini
Subfamily: Rutelinae
Subfamily: Cetoniinae
Subfamily: Melolonthinae
Subfamily: Dynastinae

The comparision between habitats (table 8) showed the great difference among [AT]-[AD], [AD]-[AM] and [AD]-[AS] habitats, whereas no significant difference showed in [AT]-[AM], [AT]-[AS] and [AM]-[AS]. Therefore one can conclude that the significant difference between habitats was seen (table 7) due to collective analysis of the data. The analysis for individual habitat (table 8) showed that the habitats with less disturbed dense forest have their unique diversity which is significantly different from areas with human intervention in structuring the habitat.

Table 8. Analysis of variance for population between different habitats ($p<0.05$)

Habitats	F	F critical	p-value
[AT]-[AD]	11.33496	4.241699	0.002462
[AT]-[AM]	0.304651	4.241699	0.585882
[AT]-[AS]	0.855041	4.241699	0.36397
[AD]-[AM]	13.48633	4.241699	0.001143
[AD]-[AS]	8.561936	4.241699	0.007206
[AM]-[AS]	0.734763	4.241699	0.399486

In all these habitats, the agricultural data was collected. The data showed that there is consistency in the cropping pattern and material used as farm inputs throughout the study area. Hence less effect of cropping pattern is considered in AD, AM and AS habitat. But some effect on species of subfamily Rutelinae and Melolonthinae was observed in AT region.

This has given better idea about local biodiversity. Alone species richness cannot be considered as indication of good ecology of any habitat unless the population dynamics are studied and compared. The ecological status of any habitat under anthropogenic pressure could be examined by comparing the parameters with the undisturbed types. If one want to restore the habitats and the biodiversity of an area then study of undisturbed habitats is proven inevitable.

C. Use of dung beetle grubs in compost making

Composting bed was prepared using bricks and cement, the dried leaves, husk and dung were added as raw material. The grubs were collected from open dung pit. *Oryctes rhinoceros* grubs were identified and introduced in the bed (approx. 300 grubs for 500 kg raw material). The chambers were kept close by wire mesh to avoid escape of grub or adult from unit and water was sprinkled every alternate day to maintain moisture. Grubs took 30 days to convert raw material into final product in the form of pellets and fine powder.

Testing of the product (grub compost) was done in analytical laboratory. The analysis was done by chemical titration and gas chromatography. The analysis reports revealed that the grub compost has equal values of nutrient levels as local vermicompost. The method was then shared with local farmers by conducting awareness programs and training programs. In total 10 awareness programs and 2 training programs were conducted. The 2 farmers who attended the training program have successfully reared the beetle grubs along with the earthworms in vermicompost unit and willing to train more people using their success as a model.

Table 9/ Analysis Report for Grub Compost

Parameters	**Unit**	**Raw Material**	**Grub Compost Sieved**	**Grub Compost Pellets**	**Vermicompost** Available data
pH	--	6.18	5.72	5.96	7.8
Organic Carbon	%	11.65	10.58	11.86	4.47
Total Nitrogen	%	0.81	0.86	0.78	0.38
Total Phosphate	%	0.21	0.40	0.43	0.87
Total Potassium	%	00	0.53	0.46	0.69
Zinc	mg/kg	1.055	0.77	0.747	No Data
Boron	mg/kg	1.055	4.6	2.1	No Data
Molybdenum	mg/kg	0.80	1.10	1.20	No Data
Iron	mg/kg	5.226	6.319	6.155	No Data
Manganese	mg/kg	2.060	2.530	1.870	No Data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4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

a. Awareness sessions and grub compost training: The 10 public awareness sessions were conducted, one in every study site. These programmes were attended by 150 farmers and 300 students. Also two training programmes were conducted for the selected 18 farmers. These farmers were not only trained to use grub composting method but also they were trained to guide other willing farmers in their area in future.

b. Collection of data and dung beetle grubs: Due to the obvious curiosity about instruments and different work local people were asking many question to the project team. To answer their questions we started involving local persons at every site in data collection. There people helped us in digging pit fall traps, setting up light and flight traps, providing electricity connections and packing material back. We could took some advantage of this and communicate with local farmers about this project.

5. Are there any plans to continue this work?

Yes. As mentioned in application of the first phase and second phase the next (third phase) step would be to assess the diversity of complete Sindhudurg district covering approx. 4500 km^2. The second phase project work study will be taken as model and implemented in different parts of district so as to cover every possible geographical zone and habitat.

6. How do you plan to share the results of your work with others?

I have already started sharing the outcome of the project with public and scientific community. I have attended Rufford conference at Runthambore, Rajasthan, India from 23rd-26th April 2017. I presented poster of the outcomes of the project with other fellows. The outcomes of the project along with project details were covered by local Newspapers (Marathi language) under title "A fruitful research on Dung beetles of Sindhudurg" (translated). The poster presentation on Grub Compost in Indian Science Congress is scheduled on 11th April 2017. Further the full length paper will be published in well-known scientific journal.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

The grants were used over 14 months. The actual project period estimated was 12 months. The field work and awareness programs were completed in time, but due to large sample space and limited expertise in taxonomic work the project got further extended by 2 months. Also data compilation and analysis did take good amount of time. Here extra time need to be dedicated for post field work, which I could certainly take in to consideration in next phase.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Trinocular Microscope	812	816	-4	Difference in actual cost
Compost Tanks (2)	507	510	-3	-do-
Projector LCD type	406	403	3	-do-
Battery Power Backup	254	250	4	-do-
Incubator	203	23	180	Due to difference in final amount received the cost was adjusted by hiring instrument instead of purchasing,
Storage boxes	183	180	3	Difference in actual cost
Pitfall traps	152	150	2	-do-
Notebook	152	150	2	-do-
Preservatives and Consumables	51	51	0	-do-
Wet preservation of specimens	47	52	-5	-do-
DTP work - Banner, posters and certificate for Workshop	51	49	2	-do-
Awareness Campaign Printing and stationery	103	100	3	-do-
Public Meetings	102	104	-2	-do-
Hands on training workshops	203	201	2	-do-
Field assistant	406	407	-1	-do-
Expert Charges	304	308	-4	-do-
Travelling	608	612	-4	-do-
Lodging and Boarding	304	320	-16	-do-
Contingencies	152	114	38	-do-
TOTAL	5000	**4800**	200	The surplus difference was adjusted with difference due to exchange rates at the time of receipt of grant. Excess expense was arranged from other source.
Funds Received	5000	4797	-203	
Total Difference			-3	

9. Looking ahead, what do you feel are the important next steps?

The next important steps are assessment of scarabaeid diversity of complete district including all habitat types and geographical zones. This is needed as only approx. 10% of target area has got assessed in the second phase of the project. Also my team has come up with suggestion that now we can focus our work in habitats which are important for flagship species of the region e.g. leopard, bison, tiger, some herpatofauna etc. With outcomes of current study the ecological status of these important habitats could be assessed while study the microfauna (scarabaeid beetle) along with cofactors involved in structuring ecology of it. Through this study the quantum anthropogenic pressure on these habitats could be assessed by comparing ecological parameters with protected areas and habitat conservation strategies could to drawn out. Also collaborations with local as well as other competent agencies would be done to implement the model in limited span of time.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did The Rufford Foundation receive any publicity during the course of your work?

Yes RSGF Logos was used in posters and banners and power point presentations. These materials were used for public awareness and training sessions, where it was specially mentioned in each session that the project was funded by Rufford Foundation, UK which supports many conservation projects all over the world.

While newspapers covered the outcomes of project the name of Rufford Foundation as funding agency was clearly mentioned in the news. Leading Marathi newspapers Pudhari, Sakal and Agrowon covered the news. These people reach over 1,000,000 families in all over Maharashtra state. The e-paper version of this news is available online on websites of these newspaper agencies.

While executing this project team came across some young enthusiasts willing to work for nature conservation by addressing different aspects of the nature. My team feel lucky to motivate these young minds to take up project and write to Rufford foundation. We will help them to develop projects and pursue those.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

12. Any other comments?

Here I would like to inform Rufford Foundation that apart from the project objectives our team has recently started surveying the current study area for coconut infestation by Oryctes rhinoceros and livestock available in the region. As while executing current work we came across fact that there could be some relation in increase in infestation and deceasing livestock in the region. To assess the same

independent study has been taken up which could be included in upcoming phase of RSGF project.

I am grateful to receive research grants from Rufford Foundation. Special thanks to Jane Raymond for the valuable support. I am thankful to Dr V.P. Uniyal, Scientist-F, Wildlife Institute of India; Dr V. Shubhalaxmi, Founder & CEO, Ladybird Environmental Consultancy and Mr. Rahul V. Khot, Curator, Bombay Natural History Society for providing their most important inputs as referee for this project. I am thankful to my experts Dr Raghunandan Athlye, Mumbai University; Mr. Pratap Chavan, B.Sc. Agriculture, Officer, Lupin Human Welfare Foundation, Kudal and my co-investigator Dr Manasi Karangutkar. I am also thankful to my field team members, farmers and local authorities for the support they provided for the successful completion of the second phase of project. I will look forward for their generous help in the further phases of the project.