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Response of insect species to fermented sugar and milk baited traps under field conditions

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Abstract
The wide distribution of insect fauna depends upon various biotic and abiotic factors in environment. Insect success is essentially contributed by their adaptability through diversity and dispersal in nature. The unpredictable weather conditions and stochastic variation in abundance of insect species contribute to sampling error in study. Moths, butterflies, flies, ants and beetles are attracted to various feeding baits. Volatile compounds emanating from fermented feeding baits showed good response towards insect attraction especially dipteran flies, when used separately compared to other combinations. However, Ethanol and Water alone showed no response to insect attraction and stimulation. Fermented sugars were superior in attracting significant numbers of insects compared to fermented milk, and other combinations with ethanol. The stimulatory efficacy of various feeding baits across the different insect orders under field trapping experiments showed a varied response from various radii (EAR). The studies aimed to identify insect texa found in cold arid region of Zanaskar region and compare their response toward various feeding baits under open conditions that varied significantly as represented by *Chi Square* (χ^2) and *Kruskal Wallis test*, with data following *Z* and *Chi Square* (χ^2) *distribution*. The maximum values of Shannon-Wener diversity were 2.08 in Diptera followed by Lepidoptera and hymenoptera. Simpson diversity recorded for Diptera was 0.835. Insect Population responses to various baits in two years were set normal (Z-test) represented graphically. The study was not limited to any particular order; traps were hanged from willow and populous tress growing in the region. The results identified 6 insect orders comprised of 16 species from 9 genera during two years of studies with distribution represented by Hurlbert rarefaction curve.

Keywords: Diversity, insect texa, molasses bait traps, curd baited traps, ethanol, zanaskar

Introduction
Insects alone account for nearly 80% of approximately 1.7 million living species known to science (Smithsonian, 2020) [39]; with amazing adaptability and diversity for the maintenance of biotic communities. They are an important part of our ecosystem performing multitude of functions like pollination (Dar *et al*. 2016a, 2016b; Dar *et al*. 2017a, Dar *et al*. 2018a; Ullah *et al*. 2020) [15, 20, 16, 42] nutrient recycling and more often damaging our crops (Kundrata *et al*. 2020; Dar *et al*. 2017b) [29, 12]. Insects are tracheate arthropods that breathe through spiracles located on lateral sides of their body wall, smell with their antennae, taste with their feet, bestowed with special organs in the abdomen, front legs and antennae for responding to various other external and internal stimuli (Chapman *et al*. 2013) [6]. Among invertebrates, wings are present only in insects marked a significant influence upon their success especially through dispersal in environment. According to International Dive Magazine (X-Ray Mag 2011) [26], most insects are terrestrial (>75%), 3-4% occupy aquatic habitats (30000-40000 species) during part of their existence, and only some percentage present in oceans<1% (100 species, comprised of 5 orders) (Cheng, 2009) [7]. Insects are attracted and responded to various substrates (Weeks *et al.* 2020) [45] and stimuli (light, temperature, humidity, sugars, sex pheromones); and among them the fermented baits were well-known as attractants (Iqbal and Feng 2020; Vitanovic *et al.* 2020) [27, 44], and were used for monitoring and detection since centuries. In some countries, experts encourage molasses traps as a component of IPM, however it is different from some specific attractants like lures to "trap out" pest population with a broadcast signal intended to disrupt insect mating e.g. fruit flies (Dar *et al.* 2015; Mir *et al*. 2014a) [11, 19]. Sugar baited traps have been a mainstay of Dipteran flies (*Musca domestica* L.) control (Howard 1911) [23]; and there is a vast literature on attractants for flies, moths, ants and other insect species, perhaps originating with the description of a trap baited with fish

heads, watermelon rinds, corncobs, and ice cream (Howard 1911) [23], sugars, milk and the rotten fruits (Baig *et al*., 2020) [2] etc.

Insect are significantly stimulated by fermented egg slurries and combinations of molasses, milk, yeast, grain, blood, banana and fruit juices (Baig *et al*., 2020; Pickens *et al*. 1973, Pickens and Miller 1987) [2]. Mulla *et al* (1977) used blends of chemicals like synthetic trimethylamine, ammonia, indole, and linoleic acid and found them as attractive to house flies like natural food baits. Fermented sugar baits were well-known as attractants for many insect species, stimulating both sexes. However, due to discovery of the first sex pheromone and their further identification (genes encoding odorant receptors and odorant-binding proteins, Yasukochi, 2020) [47] from over thousands of Lepidopteran species, the use as well as the research in the area of fermented sugar baits have significantly declined. Unlike sex pheromones that attract only males, fermented sugar baits are generic and attract both males and females; therefore sugar baits provide an advantage over sex pheromones in targeting a wide range of insect species. However, sometimes baited tarps are inconvenient to use as monitoring tools, because the wet bait traps are heavy, maintenance is time consuming, and aging significantly affects attractiveness. Optimization of the fermented sugar and milk baits, especially with regard to handling and preparation, would also provide a new tool to monitor activity of range of economically important insect species in far flung areas. Further, the identification of the volatile compounds present in fermented sugar and milk baits would represent an essential step toward transformation of these wet baits into the more convenient dry baits that are easier and cheap for farmer community to handle, prepare and install at fields and in home. This might allow for transformation of baits from generalist to more specialist attractants, targeting wide insect pests at household and from fields. Fermented sugar baited tarps are essentially important for the management of medical pests. Ethanol is generally a killing agent, but is prepared by molasses fermentation still contains 40-50% sugar; while as, the fermented milk is actually curd (bacterial fermentation) containing higher concentration of lactic acid attracting various insect species. Further, Ladakh region especially Zanaskar is known for frequent locust attack when populations is present in gregarious phase; however in solitary phases population is normally present, that can be controlled by using molasses tarps (1% water+20% molasses). Much of this work is focused on identifying an appropriate attractant that can be used for detection and monitoring of insect pest populations relied on natural products those may be used in different traps designs.

Material and Methods

Study sites and trap installation

For our study we selected four sites within the radius of 5 km near SKUAST-K, Zanaskar Padum, and all sites were chosen so as to represent typical habitats in sandy landscape, rather than habitats where a particularly rich fauna would be expected. The vegetation consists mainly of fodder grasses, field crops and vegetable crops. Major portion of land comprised of open sandy tracks, rocks and slopes. Crops densely grown round the tarps were pea, barley, wheat, oats and vegetables following the normal package of practices of SKUAST-K, however the influence of other abiotic factors like sunshine hours, growing degree days (Dar *et al*. 2018b) [9], moisture regimes, evapotranspiration (Dar *et al*. 2017e) [11], crop geometry and nitrogen application (Dar *et al*. 2014b) [10] were different from temperate areas. We used 5 different bait mixtures at different concentrations (Table-1). The idea behind these bait mixtures was that the sugar mixture may provide a carbohydrate resource suitable for attraction of a range of insect species. We used only one way (through plastic bottles) to expose the bait, and each liquid bait (bottle) was installed in patches close to vegetations on tree trunks at a height of 50 or 200 cm, respectively from ground. Bait extension were not done on roap or cloth, because of high winds and drifting of dust and sand that may deposit over baiting liquid, so limited this method of baiting. All baits were checked for the presence of insect species every 30 min over a period totaling 1.5 h/day from April to September of both years of study. Timing of the sampling throughout the period of studies were standardized with first check at dusk, 2nd at noon and 3rd at evening. All the baits were kept fully exposed to light intensity, while as the air temperature and wind speed were taken monthly. All insects encountered during each round were captured for identification as principal reference work, and even multiple counts were recorded. Complete species list and abundance data have been recorded and species which encountered with baits were collected and included in analysis. First sampling started from April and last from December (Table-2).

We employed "rarefaction methods" as an alternative way to compare species diversity between samples of communities (Hurlbert, 1971); and it is invalid to simply compare absolute species numbers between samples unless the sample sizes are equivalent, because with increasing sample size the number of recorded species also increases due to stochastic effects, even if the samples are drawn from the identical community. Therefore, Hurlbert rarefaction fit well in current situation and allows the comparison of species numbers between samples where the total numbers of individuals are different. For accessing the difference between samples in relation to baits we apply elementary statistical procedures. A total of five different bait traps were randomly installed around the Padum and all trapped insects were stored in vials with rubber stopper and preserved in 70% alcohol; and for identification purpose keys were used. The traps were installed at same distances on same date away from crops, dung and water sources to generalize the information obtained.

Effective attraction radius (EAR): The original EAR, were proposed by Byers *et al.* (1989) [5] using spherical structures, however in present experiment we used cylindrical plastic boltless for the insect baiting, therefore the modified equation becomes as:

$$\mathrm{EAR_c} = \frac{\pi . EAR2}{2. Fl}$$

Baits were produced with definite concentration (as given below) and kept in a plastic bottle of one liter capacity. Ethanol (80%) were obtained from standard company, and water used were salt free (in Zanaskar region soils contains high carbonates). The plastic bottles were cut at the sides of its head below, to allow insects to enter inside for either drinking and licking bait. Almost 5 cuts of length 20 cm and width of 2 cm were made on head side from where the bottle was hung on populous, willow and seabuck thorn plants at 2-3 feet above ground. Bait concentrations were replaced every 15 days; however traps were monitored on daily basis (morning, noon and evening).

Table 1: Concentration of different attractant formulations

Traps	Formulation type	Con. attractant/bottle trap	Interval of change
T1	Fermented sugar +Ethanol	0.15 kg +0.001 ml	15 days
T2	Fermented Milk + Ethanol	0.25 liter +0.001 ml	15 days
T3	Fermented (Suagr+Milk)	0.15 kg +0.25 kg+ Vinegar 10 ml	15 days
T4	Fermented sugar	0.15 kg + ½ liter water	15 days
T5	Fermented Milk	0.25 + ½ liter water	15 days
T6	Water	½ liter	7 days
T7	Ethanol	20 ml	Every day

Fermented milk is produced by adding lemon juice or vinegar in lukewarm milk. The ethanol when mixed with water is usually the best killing and preserving agent. We preserved insect samples in ethanol at different concentration. For example, for hymenopteran samples (wasps) and small flies we used 95% alcohol, however, we don't used ethanol for preservation of bee samples and Lepidopteran samples.

Diversity was recorded as

1. Simpson Diversity Index (D)

$$D = \frac{\Sigma\, n(n-1)}{N(N-1)}$$

1 – D

n = the total number of organisms of a particular species
N = the total number of organisms of all species

The value of ***D*** ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity.

2. Shannon Diversity Index (H)

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

Where p_i is the proportion of insect species belonging to the *i*th species in collection. In ecology, p_i is often the proportion of individuals belonging to the *i*th species in total collection.

Results and Discussion

Four taxonomic orders *viz.* Hymenoptera, Lepidoptera, Diptera and Coleoptera comprised of 16 species were identified in Zanaskar (Table-3&4). These insects were trapped in bait and abundant order most responsive to baits was Diptera Table 4. Less abundance of insects trapped could be associated to factors (environmental) which affect trap catches, and these are temperature, rainfall, wind speed and direction influence of attractant release and turbulent insect flight (especially after 2 pm, high wind starts), succinctly supported by (Pellegrino *et al*. 2013) [37]. Similarly, the effects of rain on fruit fly trapping efficiency were observed by Flores *et al*. (2017) [21] using plastic bottles baited with enzymatic hydrolyzed protein, however in Zanaskar region we also recorded few species of fruit flies (known for their strong attraction to lures; for example Mir *et al*. 2017) [34], but their response to any of the bait type evaluated were not observed. Although insect diversity at Zanaskar region is far more then we recorded in present experiment, but their activity depends exclusively on the temperatures which at times exceed a minimum level (60º F, 15 degree Celsius), high wind velocity during the periods of their activity and food availability; however no anthropogenic impact on insect diversity is yet recorded that can be said to contributed the lesser insect diversity (Dar *et al*. 2017d) [14]. Furthermore, fermented sugar baits were found well-known as attractant stimulating many insect species, which is supported by Pyke *et al.* (2020) [38] who observed that most relationships between nectar attributes for flowers and plants on successive days were non-significant. Further, the nectar-feeding pollinators should therefore decide whether to visit another flower on a plant, based on all attributes of nectar, enabling plants to manipulate pollinators through adjusting nectar content. Some plants have high deterrence due to some specific allelochemicals chemicals and morphological characteristics in their fruit and stem (Dar *et al*. 2014; Dar *et al*. 2017c) [13]; but that do not limit bees to visit their flowers. In present investigations two nocturnal moth species were observed to show good response towards fermented sugars, that is in parallel with the results of McCormick *et al*. (2019) [32] recorded that adults of *Lymantria dispar* (gypsy moth) discriminate between hosts for feeding, and prefers a host with higher sugar content. Urinovich *et al*. (2020) [43] observed that both moths and butterflies show good attraction towards sugar solutions; however nocturnal moths dominate the abundance. Female mosquitoes are well known for their strong attraction to human hosts, but plant nectar is a common energy source in their diets, containing high concentration of sugars therefore showed high attraction rates too. Further, mosquitoes learn to recognize available sugar rewards through specific signals (Barredo and DeGennaro 2020) [3]. However, in Zanaskar region moths show good response to UV-light traps that will be discussed in next article.

Over centuries many sampling efforts were done (Briggs 2018) [4] and various traps designs have been developed for stimulating and capturing insects (Tan *et al.* 2014; Lima *et al*. 2020) [41, 31] differing in colour, shape, size, attractant used and purpose. The main purposes for trapping in present experiment is to explore insect species present in cold arid region and to record their relative response to different baits. In past century it was observed that certain moths (Family: Noctuidae) can be attracted with liquids containing sugar (e.g. Steiner and Nikusch, 1994) [40] produced by food sources. In present study Hymenoptera also showed good response towards solution containing sugar. Researchers have used a variety of techniques to offer baits to insects, and among them the commonest ways of presentation were patches of liquid bait directly applied to trees or poles, or suspending materials (strings, pieces of fabric, dried fruits) which have been soaked with the liquid bait mixture (Nippel, 1976) [35]. Similarly, literature showed (Landolt *et al*. 2018) [30] that nearly 80% of the noctuid species are caught by baiting; while as Cleve (1971) [8] showed that when baiting and light trapping are done simultaneously, moths of some noctuid genera often appear at the baits in much larger numbers suggesting that estimates of abundance based on light-trapping results alone can be misleading. In our other parallel experiment under similar conditions for same time durations on UV-light traps, solar traps and pheromone traps for catch of insects, the catch performance were in order UV-light tarps>solar traps>bating traps>pheromone traps; suggesting that moth catch from both light traps were 1000 times higher compared to baiting; while as results from pheromone traps were very poor (due to adverse weather conditions). For complete faunistic or ecological inventory of the insect species of any given area, it is necessary to combine both recording techniques. Therefore, we set out to investigate whether recording insect at baits over entire season in region may yield adequate samples for quantative assessment of the species richness and response to such feeding baits.

During the current investigation, we observed that Cabbage butterfly (*Pieris brassicae*) get attracted to fermented sugar baits under good weather conditions especially after 12:00 am and ends before 2:00 pm, supported by Inoue *et al.* (2009) [24] who observed that feeding behavior in nectar-feeding insects is triggered by a sugar-receptor response chemosensilla (Inoue *et al*. 2012) [25] distributed not only on tarsi and the outside of the proboscis but also on the inside of the food canal in Lepidoptera insects. Koneri *et al* (2020) [28] observed that highest number of butterflies visit flowers containing sugars at high concentration in morning hours; however Alm *et al.* (1990) [1] recorded that female cabbage white butterflies visited artificial flowers containing sugar-amino acid nectars more frequently than flowers containing sugar-only; indicating that sugar is the main component which attracts butterflies and the attraction is independent of trap design or flower colour or type. Hymenoptera insects showed good response to fermented sugars, especially from family Halictidae genus *Lasioglossum*, since bees are normally responding well to sugar solutions as investigated by Frizzera *et al.* (2020) [22]. Halictidae is a dominant and abundant pollinator of various fruit crops and wild shrubs, and in Zanaskar it visits to various vegetable crops and weeds from May to September. Overall in the total catch, the dipterans flies e.g. fruit flies respond significantly very well to fermented sugars and milk, same is reported by Wu *et al*. (2020). Further, we observed that pheromone trap performance is very poor in Zanaskar region under adverse weather conditions, the possible reason could be that under low atmospheric pressure the behavioral modifications in insect species would reduce various activities including mating, flight, dispersal, adaptation, and oviposition; for more information read Pellegrino *et al*. (2013) [37].

Table 2: Weekly catch of insect count in various baited traps during 2019-2020

Species	Catch/month (Fermented sugar baited traps +Ethanol) T1	Catch/ month (Fermented milk baited traps +Ethanol) T2	Catch/ month (Traps with fermented sugar and milk) T3	Catch/ month (Traps with fermented sugar) T4	Catch/ month (Traps with Fermented Milk) T5	Catch/ month (Water) T6	Catch/ month (Ethanol) T7
April	W_1=0	W_1=0	W_1=0	W_1=1	W_1=0	W_1=0	W_1=0
	W_2=0	W_2=0	W_2=0	W_2=1	W_2=0	W_2=0	W_2=0
	W_3=0	W_3=0	W_3=0	W_3=2	W_3=0	W_3=0	W_3=0
	W_4=0	W_4=0	W_4=0	W_4=3	W_4=0	W_4=0	W_4=0
Mean =Σ (x̧)	0	0	0	1.75	0	0	0
May	W_5=0	W_5=0	W_5=0	W_5=2	W_5=0	W_5=0	W_5=0
	W_6=0	W_6=0	W_6=0	W_6=3	W_6=1	W_6=0	W_6=0
	W_7=0	W_7=0	W_7=0	W_7=3	W_7=1	W_7=0	W_7=0
	W_8=0	W_8=0	W_8=0	W_8=5	W_8=1	W_8=0	W_8=0
Mean =Σ (x̧)	0	0	0	3.25	0.75	0	0
June	W_9=0	W_9=0	W_9=0	W_9=4	W_9= 2	W_9=0	W_9=0
	W_{10}=0	W_{10}=0	W_{10}=0	W_{10}=5	W_{10}=3	W_{10}=0	W_{10}=0
	W_{11}=1	W_{11}=0	W_{11}=1	W_{11}=3	W_{11}=4	W_{11}=0	W_{11}=0
	W_{12}=2	W_{12}=0	W_{12}=2	W_{12}=3	W_{12}=3	W_{12}=0	W_{12}=0
Mean =Σ (x̧)	0.75	0	0.75	3.75	3.0	0	0
July	W_{13}=1	W_{13}=0	W_{13}=3	W_{13}=3	W_{17}=3	W_{17}=0	W_{17}=0
	W_{14}=3	W_{14}=1	W_{14}=5	W_{14}=5	W_{18}=5	W_{18}=0	W_{18}=0
	W_{15}=2	W_{15}=2	W_{15}=6	W_{15}=6	W_{19}=4	W_{19}=1	W_{19}=0
	W_{16}=2	W_{16}=3	W_{16}=8	W_{16}=5	W_{20}=4	W_{20}=0	W_{20}=0
Mean =Σ (x̧)	2.0	1.50	5.50	4.75	4.00	0.25	0
August	W_{17}=2	W_{17}=2	W_{17}=4	W_{17}=7	W_{17}=4	W_{17}=1	W_{17}=0
	W_{18}=2	W_{18}=2	W_{18}=5	W_{18}=6	W_{18}=3	W_{18}=0	W_{18}=0
	W_{19}=1	W_{19}=1	W_{19}=5	W_{19}=4	W_{19}=2	W_{19}=0	W_{19}=0
	W_{20}=1	W_{20}=1	W_{20}=3	W_{20}=3	W_{20}=1	W_{20}=0	W_{20}=0
Mean =Σ (x̧)	1.5	1.5	4.25	5.00	2.50	0.25	0.25
September	W_{21}=1	W_{21}=1	W_{21}=3	W_{21}=2	W_{21}=0	W_{21}=1	W_{21}=0
	W_{22}=1	W_{22}=0	W_{22}=1	W_{22}=1	W_{22}=0	W_{22}=0	W_{22}=0
	W_{23}=1	W_{23}=0	W_{23}=0	W_{23}=1	W_{23}=0	W_{23}=0	W_{23}=0
	W_{24}=1	W_{24}=0	W_{24}=0	W_{24}=1	W_{24}=1	W_{24}=0	W_{24}=0
Mean =Σ (x̧)	1.0	0.25	1.0	1.25	0.25	0.25	0
October	W_{25}=0	W_{25}=0	W_{25}=0	W_{25}=1	W_{25}=0	W_{25}=0	W_{25}=0
	W_{26}=0	W_{26}=0	W_{26}=1	W_{26}=1	W_{26}=0	W_{26}=0	W_{26}=0
	W_{27}=0	W_{27}=0	W_{27}=0	W_{27}=0	W_{27}=0	W_{27}=0	W_{27}=0
	W_{28}=0	W_{28}=0	W_{28}=0	W_{28}=0	W_{28}=0	W_{28}=0	W_{28}=0
Mean =Σ (x̧)	0	0	0.25	0.50	0	0	0
November	W_{29}=0	W_{29}=0	W_{29}=0	W_{29}=0	W_{29}=0	W_{29}=0	W_{29}=0

	$W_{30}=0$	$W_{30}=0$	$W_{30}=0$	$W_{30}=0$	$W_{30}=0$	$W_{30}=0$	$W_{30}=0$
	$W_{31}=0$	$W_{31}=0$	$W_{31}=0$	$W_{31}=0$	$W_{31}=0$	$W_{31}=0$	$W_{31}=0$
	$W_{32}=0$	$W_{32}=0$	$W_{32}=0$	$W_{32}=1$	$W_{32}=0$	$W_{32}=0$	$W_{32}=0$
Mean $=\sum (x)$	0	0	0	0.25	0	0	0
December	$W_{33}=0$	$W_{33}=0$	$W_{33}=0$	$W_{33}=1$	$W_{33}=0$	$W_{33}=0$	$W_{33}=0$
	$W_{34}=0$	$W_{34}=0$	$W_{34}=0$	$W_{34}=0$	$W_{34}=0$	$W_{34}=0$	$W_{34}=0$
	$W_{35}=0$	$W_{35}=0$	$W_{35}=0$	$W_{35}=0$	$W_{35}=0$	$W_{35}=0$	$W_{35}=0$
	$W_{36}=0$	$W_{36}=0$	$W_{36}=0$	$W_{36}=0$	$W_{36}=0$	$W_{36}=0$	$W_{36}=0$
Mean $=\sum (x)$	0	0	0	0.25	0	0	0
	N=21	N=23	N=46	N=80	N=42	N=2	N=0

Note: Conducting Kruskal Wallis test, K= 130.33, Critical value=15.08, and P value comes <5% (0.00000022); indicating that one of the fermented sugar is highly significant among all traps baits we tested.

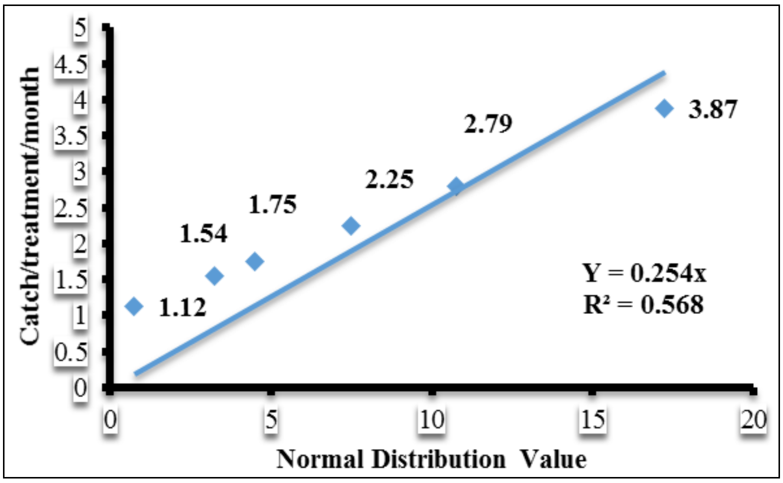

Fig 1: Data were set normal (Normality curve) with order=1, range=0-20, sum of ranks=21, and index=4.43 Regression trend line (Y) = 0.25x, R^2= 0.568. (Points on line are index values of Z)

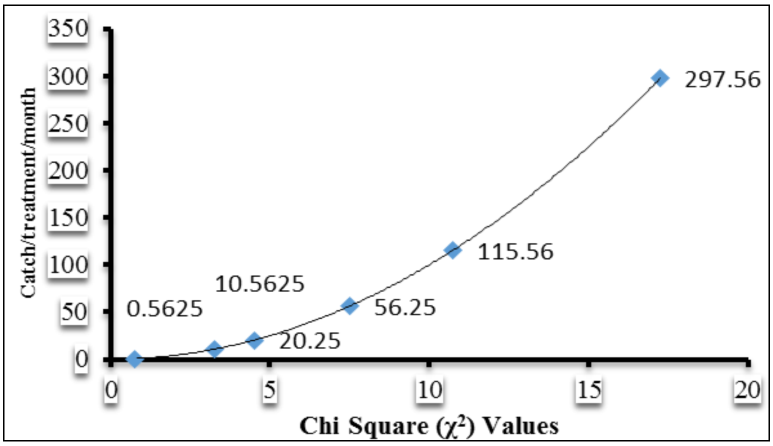

Fig 2: Chi Square (χ^2) Distribution graph with order=1, range 1-20, points on line are index values of Z^2

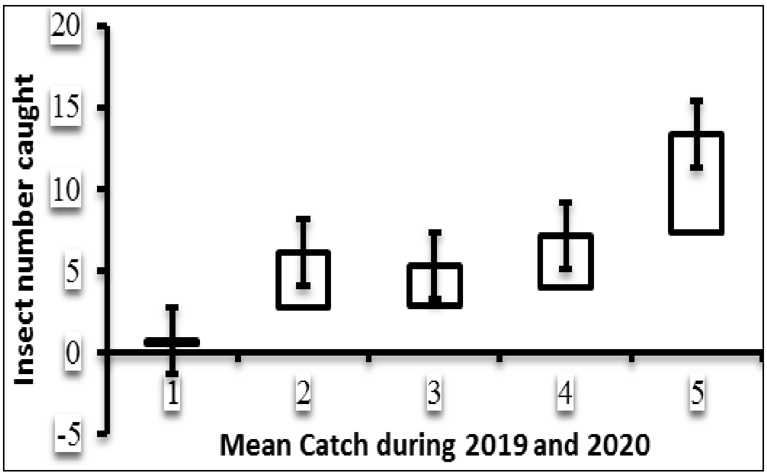

Fig 3: Box plot for the mean samples collection during two years

After adjusting the data set of the total average catch for five months (April-September for two years), we calculated Chi square (χ^2) test takingsum of column and the degree of freedom. We calculated P-value from Chi-square (χ^2) score (=74) with d.f 5, value <0.05 (=<0.0001); indicating that average catch over five months (May-September) differ significantly. Active weeks represents the weeks of best catch.

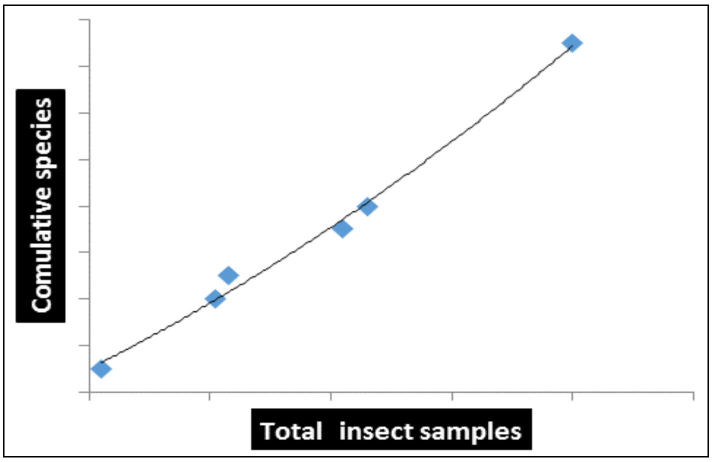

Fig 4: Hurlbert rarefaction curves of 243 randomized samples with 16 species collected in various bait traps

Table 3: Species wise catch/month of various insects using various treated traps installed at similar height on forestry trees at Zanaskar 2019-20

Species/Genus	T1	T2	T3	T4	T5	T6	T7	Significance	
	Catch/month (Fermented sugar baited traps +Ethanol) T1	Catch/ month (Fermented milk baited traps +Ethanol) T2	Catch/ month (Traps with fermented sugar and milk) T3	Catch/ month (Traps with fermented sugar) T4	Catch/ month (Traps with Fermented Milk) T5	Catch/ month (Water) T6	Catch/ month (Ethanol) T6	χ^2 test= P-value=	Simpson Diversity Index (D)
Diptera									
Musca sorbens	3	1	4	12	3	1	0	16.26 <0.05%	0.835
Musca domestica	6	3	12	23	4	0	0	0.56 >0.05%	
Musca autumnalis	3	1	5	11	4	0	0	11.22 <0.05%	
Calliphoridae	2	1	3	4	3	0	0	30.65 <0.05%	
Syrphds species	1	0	1	1	1	0	0	45.79 <0.05%	
Tachind species	1	0	2	2	2	0	0	40.41 <0.05%	
Culicidae	2	2	3	2	2	0	0	-	
	N= 18	N= 8	N= 30	N= 55	N= 21	N= 1	N=0		
Shannon-wiener index/Shannon entropy (P*nl)=	0.229	0.13	0.29	0.36	0.24	0.02	0.06		
Lepidoptera									
Pieriesbrassicae	0	0	1	3	2	0	0	2.28 <0.0001	0.933
Helicoverpa armigera	1	2	4	4	6	1	0	1 <0.0001	
Agrotis epsilon	1	1	3	3	4	0	0	4 0.84 (>0.05)	
Erebidae moth spp.	1	2	2	2	4	0	0	5.44 0.90 (>0.05)	
Shannon-wiener index/Shannon entropy (P*nl)=	0.06	0.099	0.160	0.179	0.214	0.028	0		
	N= 3	N= 5	N= 10	N=12	N= 16	N= 1	N=0		
Hymenoptera									
Monomorium minimum	0	0	2	4	2			<0.05%	0.934
Camponotus spp.	0	0	2	3	1	0	0	<0.05%	
Lasioglossum spp.	0	0	2	4	1	0	0	<0.05%	
Wasps	0	0	1	1	0	0	0	<0.05%	
Shannon-wiener index/Shannon entropy (P*nl)=	0	0	0.100	0.180	0.099	0	0		
	N= 0	N= 0	N= 6	N= 13	N= 5	N= 0	N=0	-	
Coleoptera								-	
Beetles	0	0	1	0	0	0	0	--	0
	N=0	N=0	N=1		N=0	N=0	N=0		

Note: Shannon-wiener index/Shannon entropy Σ(P**nl*)=2.448 (moderate diversity)

Table 4: Effective Attraction Radius EAR (meters) through baiting traps installed equidistantly at Zanaskar

Species/Genus	T1 Catch/month (Fermented sugar baited traps +Ethanol)	T2 Catch/ month (Fermented milk baited traps +Ethanol)	T3 Catch/ month (Traps with fermented sugar and milk)	T4 Catch/ month (Traps with fermented sugar)	T5 Catch/ month (Traps with Fermented Milk)	T6 Catch/ month (Water)	T7 Catch/ month (Ethanol)
Diptera							
Musca sorbens	10.5 ft	7 ft	15 ft	25 ft	12 ft	0.5 ft	-
Musca domestica	9.5 ft	6 ft	12 ft	22 ft	14 ft	-	-
Musca autumnalis	11 ft	8 ft	13 ft	23 ft	10 ft	-	-
Calliphoridae	9 ft	5 ft	12 ft	15 ft	10 ft	-	-
Syrphds species	8.5 ft	4 ft	7 ft	12 ft	12 ft	-	-
Tachind species	9 ft	-	5 ft	14 ft	7 ft	-	-
Culicidae	5 ft	-	4 ft	5 ft	5 ft	-	-
	N= 7	N=5	N= 7	N= 7	N= 7	N= 1	N= 0
Significance	**χ^2 value=169.75, d.f.=7, p<0.001% (μ =2.26501E-09)**						
Lepidoptera							
Pieris brassicae	-	-	5 ft	10 ft	4 ft	0	0
Helicoverpa armigera	NA	NA	NA	NA	NA	0	0
Agrotis epsilon	NA	NA	NA	NA	NA	0	0
Erebidae moth spp.	NA	NA	NA	NA	NA	0	0
	N= 0	N=0	N=1	N=1	N=1	N=0	N=0
Hymenoptera							
Monomorium minimum	-	-	5 ft	6 ft	4 ft	-	-
Camponotus spp.	-	-	4 ft	6 ft	5 ft	-	-
Lasioglossum spp.	-	-	15 ft	19 ft	9 ft	-	-
Wasps	-	-	16 ft	22 ft	10 ft	-	-
	N= 0	N=0	N=4	N=4	N=4	N=0	N=0
Significance	**χ^2 value= 60.5, p value<0.001%, d. f. 4 (μ=2.43146E-14)**						
Coleoptera							
Beetles	0	0	½ ft	0	0	0	0

Note; Ft stands for foot, 1 ft =30.48 centimeters

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