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Portfolio function of Bihar hairy caterpillar species, *Spilosoma spp*. with respect to its species diversity profile in Saharsa, Bihar, India

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Abstract: Portfolio function is an investment term usually applied used in finance management but due to the unpredicted loss & gain of biodiversity, population biologist and environmentalist have started using this concept in biodiversity studies. When more diversity is added to any investment portfolio, less risk is involved, hence community rich in biodiversity is considered to be rich in bioresources with ample security & insurance in contrast to those having less diversity of species. The functional concept of community & ecosystem is almost equal to well organised portfolios of the nature (Frank Figge 2004).[1] In the present research paper the author has ventured to apply the portfolio theory in the population diversity of Bihar hairy caterpillar, *Spilosoma* spp. randomly sampled from different agricultural & weedy plots of Saharsa. Eight species sampled from four zones of this area have collective species diversity index value (S-W=H) of 0.7002 (Z-1), 0.7627 (Z-2), 0.7909 (Z-3) & 0.8564 (Z-4) calculated by applying standard statistical equation to the sampled population. The value reflects that zone-4 is richest in terms of *Spilosoma* spp population thriving on different host weeds & crops in this area but largely destroying the host asset (weeds & crops). The diversity value of the pest in zone-1 is poorest that also indicates the smart portfolio management of the nature with respect to the population of weeds & host crops. Crisscross interrelationship & implications of such diversity of the pest & host in the portfolio function of the hairy caterpillar has been discussed under the light of investment policies of nature in the communities.

Keywords: Portfolio function, species diversity, investment policies, *Spilosoma* spp, post weeds & crops, Saharsa district

INTRODUCTION

Portfolio function is a very advanced concept of asset and liability management with precise monitoring of loss & gain of the resources in nature if considered to be the ultimate reserve bank of all the resources existing in it.[2] One of the most pervasive themes in insect ecology is that biological diversity stabilizes ecosystem processes and the service they provide to society, a concept that has become a common argument for biodiversity conservation. Species rich communities are thought to produce more temporally stable ecosystem service because of the complementary or independent dynamics among species that perform similar ecosystem functions. Such variance dampening within communities is referred to as portfolio effect and is analogous to the effects of asset diversity on the stability of financial portfolios[3]. in ecology, these arguments have focused on the effects of species diversity on ecosystem stability but have not considered the importance of biologically relevant extirpation are probably at least three orders of magnitude higher than species extinction rates. So there is a pressing need to clarify how population and life history diversity affect the performance of individual species in providing important ecosystem services.

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Variability in annual Bristol Bay salmon returns is 2.2 times lower than it would be if the system consisted of single homogenous population rather than the several hundred discrete populations it currently consists of. Our results demonstrate the critical importance of maintaining population diversity for stabilizing ecosystem services and securing the economies and livelihoods that depends on them. All the resources in the nature whether living or non living under the portfolio function are considered to be natural assets. And low or high population density of any assets becomes the prerogative of the nature. Beyond the control of human being but within the limits of research thought of human minds, the increase & decrease of any resource species is directly related to their positive or negative performance in the environment which immediately concern the adjoining members of the species lying in that portfolio.

MATERIAL AND METHODS

In the present investigation, various species of *Spilosoma* has been surveyed and sampled along with their host weeds and crops of agricultural fields from four different zones of Saharsa district like zone-1 (South Saharsa)- Salkhua, Banma Itiahri, zone-2 (West)- Mahishi, Kahara & Simri Bakhtiarpur), zone-3 (North)-Nauhatta & Satar Kataiya & zone-4 (East)-Patarghat, Sonbarsa, Saur bazar, through large quadrate sampling and random netting methods. The numerical count of the individuals of pest species in live condition thriving on the specific weed during sampling has been recorded in the raw data diversity computation tables 1-4 (zone specific) and the scientific identification of the species were done on the spot as far as possible & also in the lab by preserving & bringing few representatives of the samples for identification with standard key of Lepidoptera. Shannon Weiner index is also known as Shannon Weaver index.[4,5,6]

The types of host weeds were also ascertained with the help of local people & botanist to co-relate their abundance with the diversity of the *Spilosoma* pest as well as interpret the portfolio function as per natural bioresource asset investment policies of the nature or environment. The four sampling zones of various species of *Spilosoma* along with the host weeds have been displayed in the Fig.1 of Tehsil map of urban area of Saharsa district. The number of individuals of pest species along with the host weeds counted in each quadrate sampling or netting and their species identity have been presented in the raw data table no. 1. Table no. 2 reflects the statistical computation of species wise relative abundance whereas Shannon Wiener diversity has been presented in the table no.3. The graphical representation of rank abundance curve has been furnished in the figure of the histogram.

Following statistical tools have been used for the purpose:

a) S.W. diversity index: -

H= pi log pi

Where, H = species diversity,

Pi = mean of individual species procured by the formula n/N,

log pi is the log product of pi (mean of individual species).

b) Relative abundance = ni/N x 100

Where, Ni = number of individuals of a species.

c) Portfolio function index (PF)=No. of host plants/$_{\mathbf{H}}$

d) 3-D histogram graphical co-relation between species diversity of *Spilosoma* and population dynamics of host plants.

RESULT & DISCUSSION

The results of species diversity by applying S-W diversity statistical tool in different zones of sampling in Saharsa district furnish the information that zone-1 is having lowest diversity value of the pest (0.7002) thriving on 13-15 host plants per quadrate sample. In contrast to this zone-4 is having highest diversity value (0.8564) for the pest. Surprisingly the portfolio function index (PF) which is a ratio of host population dynamics vs pest species diversity reflected just reverse trend in the form of highest Pf value in zone-1 whereas lowest in zone-4.

The relative performance of the pest species diversity on the selected host plants & the ability of the hosts to withstand the pest attack are two important hand-in-glove phenomenons that keep operating the portfolio function of the habitat. Apropos, the species diversity of the pest in highly dense population host weeds is relatively low, although the rich availability of food should have expectedly encouraged the growth of pest that didn't happen. Other components in the portfolio of the habitat operating as diversified investment channels such as metrological conditions, anthropogenic attention & pest control measures taken up in advance to maintain the habitat ecosystem related to the host plants, weeds & other economic trees susceptible to the attack of Bihar hairy caterpillar, *Spilosoma* spp.

Fig-1. Tehsil map of Saharsa, Bihar showing four zones of sampling of *Spilosoma* spp. along with host weeds & plants

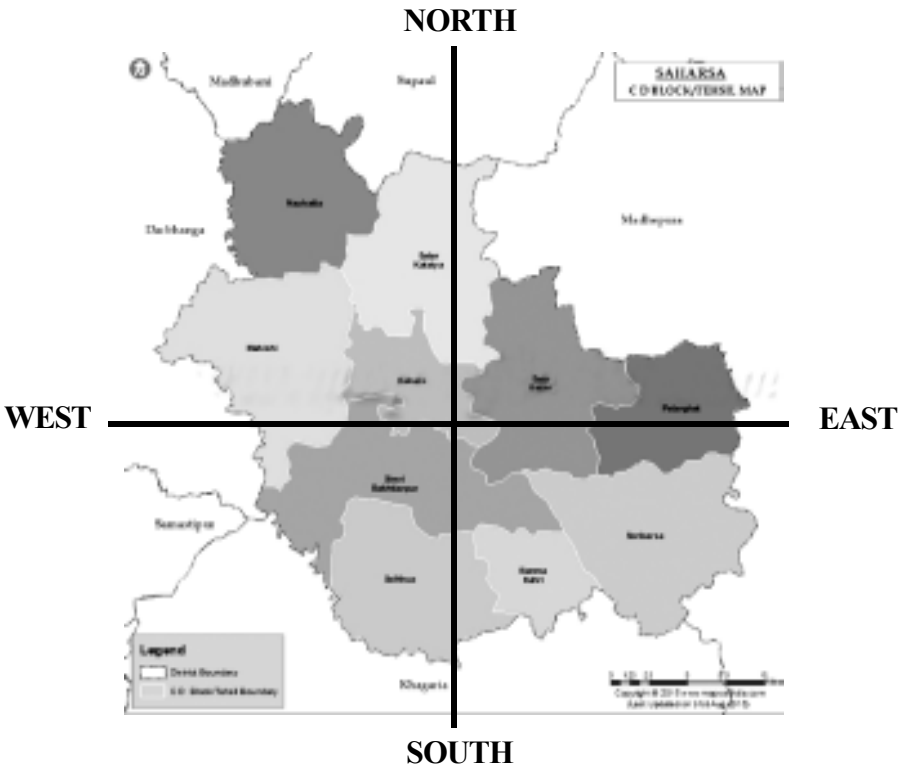

Table 1: Zone specific diversity index values of Bihar hairy caterpillar *Spilosoma spp.* of Saharsa, in zone 1 (South Saharsa)- Salkhua, Banma Itiahri

Sl. no	Scientific name as per the key	Taxonomic position	Name of the host weeds /plants	Quadrate plot no.	Number of adult insects per quadrat of weeds(10-15 plants)	Relative abundance %(n/N* 100)	Pi(n/N)	log pi	Pi*log pi	H
1	*Spilosoma congrua*	Lepidoptera	Tobacco	Z-1/QP-i	11	22.9	0.229	-0.640	-0.1465	0.7002
2	*Spilosoma fuscipennis*	Lepidoptera	Onion	Z-1/QP-ii	08	16.6	0.166	-0.779	-0.1293	
3	*Spilosoma virginica*	Lepidoptera	Papaya	Z-1/QP-ii	07	14.5	0.145	-0.838	-0.1215	
4	*Spilosoma erythrozona*	Lepidoptera	Mango	Z-1/QP-iii	04	8.3	0.083	-0.080	-0.0066	
5	*Spilosoma urticae*	Lepidoptera	Tobacco	Z-1/QP-iv	06	12.5	0.125	-0.903	-0.1128	
6	*Spilosoma lubricipeda*	Lepidoptera	Papaya	Z-1/QP-ii	04	8.3	0.083	-0.080	-0.0066	
7	*Spilosoma erythrophleps*	Lepidoptera	Mango	Z-1/QP-iii	03	6.2	0.062	-1.207	-0.0748	
8	*Spilosoma obliqua*	Lepidoptera	Garlic	Z-1/QP-ii	05	10.41	0.104	-0.982	-0.1021	
	Total				48					

PF index (portfolio function) = number of host plants per quadrate/ & =13/0.7002=18.56

Table 2: Zone specific diversity index values of Bihar hairy caterpillar *Spilosoma spp.* of Saharsa, in zone 2 (West Saharsa)-Mahishi, Kahara & Simri Bakhtiarpur

Scientific name as per the key	Taxonomic position	Name of the host weeds/plants	Quadrate plot no.	Number of adult insects per quadrat of weeds(15-20 plants)	Relative abundance %(n/N* 100)	p_i(n/N)	log p_i	p_i*log p_i	H
Spilosoma congrua	Lepidoptera	Tobacco	Z-2/QP-i	11	22.4	0.224	-0.649	-0.1453	
Spilosoma fuscipennis	Lepidoptera	Onion	Z-2/QP-ii	08	16.32	0.163	-0.787	-0.1282	
Spilosoma virginica	Lepidoptera	Papaya	Z-2/QP-ii	07	14.2	0.142	-0.847	-0.1202	
Spilosoma erythrozona	Lepidoptera	Mango	Z-2/QP-iii	04	8.16	0.081	-0.091	-0.0073	0.7627
Spilosoma urticae	Lepidoptera	Tobacco	Z-2/QP-iv	06	12.2	0.122	-0.913	-0.1113	
Spilosoma lubricipeda	Lepidoptera	Papaya	Z-2/QP-ii	08	16.32	0.163	-0.787	-0.1282	
Spilosoma erythrophleps	Lepidoptera	Mango	Z-2/QP-iii	01	2.04	0.020	-1.698	-0.0339	
Spilosoma obliqua	Lepidoptera	Garlic	Z-2/QP-ii	04	8.16	0.081	-1.091	-0.0883	
Total				49					

PF index (portfolio function) = number of host plants per quadrate / & =13/0.7627 =17.04

Table 3: Zone specific diversity index values of Bihar hairy caterpillar *Spilosoma spp.* of Saharsa, in zone 3 (North Saharsa)-Nauhatta & Satar Kataiya

Scientific name as per the key	Taxonomic position	Name of the host weeds/plants	Quadrate plot no.	Number of adult insects per quadrat of weeds(10-15 plants)	Relative abundance %(n/N* 100)	P_i(n/N)	log p_i	P_i*log p_i	H
Spilosoma congrua	Lepidoptera	Tobacco	Z-3/QP-i	11	19.29	0.192	-0.716	-0.1368	
Spilosoma fuscipennis	Lepidoptera	Onion	Z-3/QP-ii	08	14.03	0.140	-0.853	-0.1194	
Spilosoma virginica	Lepidoptera	Papaya	Z-3/QP-ii	07	12.2	0.122	-0.913	-0.1113	0.7909
Spilosoma erythrozona	Lepidoptera	Mango	Z-3/QP-iii	04	7.01	0.070	-1.154	-0.0807	
Spilosoma urticae	Lepidoptera	Tobacco	Z-3/QP-iv	06	10.5	0.105	-0.978	-0.1026	
Spilosoma lubricipeda	Lepidoptera	Papaya	Z-3/QP-ii	06	10.5	0.105	-0.978	-0.1026	
Spilosoma erythrophleps	Lepidoptera	Mango	Z-3/QP-iii	05	8.77	0.087	-0.060	-0.0052	
Spilosoma obliqua	Lepidoptera	Garlic	Z-3/QP-ii	10	17.5	0.175	-0.756	-0.1323	
				57					

PF index (portfolio function) = number of host plants per quadrate/ & = 13/0.7909 =16.43

Table 4: Zone specific diversity index values of Bihar hairy caterpillar *Spilosoma spp.* of Saharsa, in zone 4 (East)-Patarghat, Sonbarsa, Saur bazar

Scientific name as per the key	Taxonomic position	Name of the host weeds/plants	Quadrate plot no.	Number of adult insects per quadrat of weeds(10-15 plants)	Relative abundance %(n/N* 100)	P_i(n/N)	log p_i	P_i*log p_i	H
Spilosoma congrua	Lepidoptera	Tobacco	Z-4/QPi	11	21.56	0.215	-0.667	-0.1434	0.8564
Spilosoma fuscipennis	Lepidoptera	Onion	Z-4/QP-ii	08	15.68	0.156	-0.806	-0.1257	
Spilosoma virginica	Lepidoptera	Papaya	Z-4/QP-ii	07	13.7	0.137	-0.863	-0.1182	
Spilosoma erythrozona	Lepidoptera	Mango	Z-4/QP-iii	04	7.84	0.078	-1.107	-0.0863	
Spilosoma urticae	Lepidoptera	Tobacco	Z-4/QP-iv	06	11.76	0.117	-0.931	-0.1089	
Spilosoma lubricipeda	Lepidoptera	Papaya	Z-4/QP-ii	09	17.64	0.176	-0.754	-0.1327	
Spilosoma erythrophleps	Lepidoptera	Mango	Z-4/QP-iii	02	3.92	0.039	-1.408	-0.0549	
Spilosoma obliqua	Lepidoptera	Garlic	Z-4/QP-ii	04	7.84	0.078	-1.107	-0.0863	
Total				51					

PF index (portfolio function) = number of host plants per quadrate/ & = 13/0.8564 =15.17

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