Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

ISSN 2320-7078
JEZS 2014; 2 (6): 123-130

Received: 24-10-2014
Accepted: 15-11-2014

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Pattern of butterfly distribution and biodiversity in spatial and temporal dimensions in North Iran

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Abstract
A study on Butterflies (Lepidoptera), was carried out in the region of Semnan and Mazandaran Province, Iran, from the 1st May 2009 till the 1st October 2009. Butterfly's sampling was done at 20 collection stations, placed at the diverse sites of the provinces with absolutely different climatic condition and also remarkable variety in flowering variation in the herb layer. The study resulted in record of 6222 butterfly specimen representing five different families and 96 species. In addition α-diversity in spatial and temporal dimensions, and β-diversity of butterflies in this survey were utilized to study the biodiversity of butterflies. In spatial dimension, Syah Khani and Nam Rud showed the highest and lowest species diversity, respectively; Firuz Kuh and Bastam showed the highest and lowest evenness, respectively, and Khosh Yeylaq and Bastam showed the highest and lowest richness index, respectively. While in temporal dimension, June and May showed the highest and lowest species diversity; July and September showed the highest and lowest richness, and September and June showed the highest and lowest species evenness index, respectively. Syah khani station in the month of June, and Behshahr station in the month of September showed the highest and lowest species richness, respectively. Syah khani station in the month of June, and Bastam station in the month of August showed the highest and lowest species diversity, respectively. As for the species evenness, the maximum and minimum values were seen in Kelateh Rudbar in the month of July and Gursefid in the month of May, respectively. In view point of β-diversity Kelateh rudbar was more widespread transect and Syah khani was the more restricted transect. Znd also Kelateh rudbar and Cheshme Ali indicated more similarity in species composition and Behshahr and Syah khani showed more dissimilarity in context of species composition.

Keywords: α-diversity; β-diversity; Butterfly; dissimilarity; similarity; spatial dimensions; Iran; Mazandaran province; Semnan province.

1. Introduction
In recent years, the focus of nature conservation efforts has become more inclusive, broadening from an approach emphasizing flagship species like cranes, sea turtles or tiger to embrace the entire diversity of life. Thus, biological diversity is now increasingly recognized as a vital parameter to assess global and local environmental changes and sustainability of developmental activities. It is important to distinguish species richness when assemblages differ strongly in total abundance [1]. Most studies of species diversity are standardized on the basis of area or sampling effort, and therefore describe species density [2]. The most commonly – used index of biodiversity is the number of species, i. e., and species diversity. In addition, the diversity indices that take into account the distribution of individuals among species have been standardized [3]. However, the validity of species richness models as tools for predicting future species assemblages may be limited, because the importance of climatic factors in determining species richness varies with spatial scale (grain and extent) [4, 5], at large spatial scales most available evidence suggests that climate gradients have the strongest correlations with species richness, whereas at finer spatial scales the patterns are less clear-cut [5]. During recent years, an increasing number of studies have discussed the relative importance of climate and land cover in determining individual species distributions [6]. Butterflies belong to the order Lepidoptera exhibit an extensive dispersion and distribution due to their evolutionary capability to adapt themselves morphologically and physiologically to different natural conditions. In addition documenting the spatial and temporal distribution patterns of the butterflies can help us to identify their general ecological properties in a given area. Biodiversity shows many patterns in space and time due to the differences in climate conditions, interactions between species, geography, local history, and many other factors.

The patterns of biodiversity in space are composed of area, latitude and altitude, etc., while those in time consist of season, life history, and others. Documenting the spatial and temporal distribution patterns of the butterflies can help us to identify their general ecological properties in a given area. In this study, we investigated the patterns of butterflies species and their biodiversity in spatial and temporal dimensions in two provinces at the north of Iran, Semnan and Mazandaran, which are enclosed among Caspian Sea, Alborz mountain range and Dashte Kavir. Mazandaran province enjoys a moderate, subtropical climate with an average temperature of 25 °C in summer and about 8 °C in winter. Although snow may fall heavily in the mountains in winter, it rarely falls at sea level. In Semnan province summers tend to be very hot and dry with average daytime temperatures hovering around 37 °C. Meanwhile, the winters are cold and gusty, and occasionally wet. Semnan does witness snowfall, and the median amount of precipitation hovers around 232 millimeters. The average number of icy and below freezing days per year in Semnan is roughly 48 days according to Iranian Meteorology reports. By analyzing standardized butterfly data collected at distinct sites at 20 different stations in 2009, we now examine whether current species assemblages can be modeled using climatic variables.

2. Materials and Methods

2.1 Study system

A methodology which involved sampling in 4-5 times around every sampling site. All the butterflies on the round as well as 5 m on either side were recorded with time, number of individuals seen. Other parameters such as weather condition, host plants and geographic characteristics within a site were recorded. In the survey, butterflies were counted during suitable conditions for butterfly activity (sunshine and no more than light wind, between 10:00 h and 16:00 h Iranian Spring and Summer Time).

2.2 Description of collection sites and localities

The fieldwork was conducted at twenty localities in Semnan (35.5769°N 53.3953°E) and Mazandaran (36.5656°N 53.0588°E) provinces; an area enclosed among Caspian Sea, Alborz Mountain Range and Dashte Kavir, at the North of Iran, from May 2009 till September 2009, almost 150 days.Every locality was visited once per month during this period.

2.3 Caspian Sea

The Caspian Sea is the largest inland body of water in the world and accounts for 40 to 44 percent of the total lacustrine waters of the world. The drastic changes in climate alongside the Caspian have led to a great deal of biodiversity in the region.

2.4 Alborz Mountain range

Mount Damavand, Iran's tallest mountain is located in the Alborz mountain range. The tallest mountain in the Middle East, Mount Damavand, is located in the range. The Alborz mountain range forms a barrier between the south Caspian and the Qazvin-Tehran plateau.

2.5 Dasht-e Kavir

Dasht-e Kavir, also known as Kavir-e Namak or Great Salt Desert is a large desert lying in the middle of the Iranian plateau. It is about 800 kilometers (497 mi) long and 320 kilometers (198 mi) wide with a total surface area of about 77,600 square kilometers, making it the world's 23rd largest desert.

2.6 Semnan Province

Semnan is located in the north of the country. The province of Semnan covers an area of 96,816 square kilometers and stretches along the Alborz mountain range and margins to Dasht-e Kavir desert in its southern parts.15 localities in this province were surveyed for their butterfly fauna.

2.7 Mazandaran Province

Mazandaran province is located on the southern coast of the Caspian Sea in the north of Iran with 23,842 km^2 area [7]. Mazandaran province is geographically divided into two parts: the coastal plains, and the mountainous areas. Five localities in this province were surveyed regarding their butterflies fauna.

2.8 Identifying the specimens

Taxonomic identification was done by using keys available in the book "Butterflies of Iran" by Nazari, 2003, with the help of one of the biggest Iranian lepidopterists, Mr. Alireza Naderi (Natural history museum of Iran, Tehran, Iran).

2.9 Biodiversity index

In the present study, α- biodiversity, i. e., species diversity, richness and evenness, were adopted, in order to study the biodiversity of butterflies in spatial and temporal dimensions in the study area. All these indices are prescribed for measuring spatial and temporal dimensions. In addition β-Diversity of butterflies, i. e., Ubiquity and Similarity was investigated by using "Bio Diversity Pro" software; Individuals of a given species may occur on several of transects sampled of which the index ubiquity shows this amount with numbers between 0 and 1. The more the value of ubiquity is near to 0, then more restricted is distribution in the set of species found on a given transect; and the more this value is near to 1, then more widespread is the distribution of the set of species found on a given transect.

3. Results

3.1 Species Composition

A total of 6222 individual butterflies were collected during the survey. Taxonomic analysis of the collected butterfly species revealed the record of 96 species of Butterflies belonging to 2 super families, 5 families, 12 Subfamilies and 45 Genera (Table 1).

Table1: Checklist of Butterflies recorded from the collection sites during the study.

Superfamily	Family	Genera	Species
PAPILIONOIDEA	PAPILIONIDAE	*Iphichlides*	*Iphichlides podalirius* LINNAEUS, 1758
		Papilio	*Papilio demoleus* LINNAEUS, 1758
	PIERIDAE	*Aporia*	*Aporia crataegi* LINNAEUS, 1758
		Pieris	*Pieris brassicae LINNAEUS, 1758*
			Pieris rapae LINNAEUS, 1758
			Pieris ergane GEYER 1828

			Pieris (napi) pseudorapae VERITY, 1908
		Pontia	*Pontia (daplidice) daplidice LINNAEUS, 1758*
		Euchloe	*Euchloe (Euchloe) persica Verity 1911*
			Euchloe (Elphinstonia) transcaspica STAUDINGER, 1892
		Colias	*Colias erate erate ESPER, 1805*
			Colias crocea FOURCROY, 1758
			Colias sagartia sagartia LEDERER, 1870
			Colias aurorina aurorina HERRICH-SCHAFFER, 1850
		Gonepteryx	*Gonepteryx rhamni transiens VERITY, 1913*
			Gonepteryx farinosa turcirana DE FREINA, 1990
	LYCAENIDAE	*Cigaritis*	*Cigaritis epargyros transcaspica EVERSMANN, 1854*
		Lycaena	*Lycaena phlaeas phlaeas LINNAEUS, 1761*
			Lycaena tityrus tityrus PODA, 1761
			Lycaena thersamon ESPER, 1784
			Lycaena alciphron melibaeus STAUDINGER, 1878
		Callophrys	*Callophrys suaveola STAUDINGER, 1881*
		Satyrium	*Satyrium abdominalis GERHARD, 1850*
			Satyrium hyrcanicum RILEY, 1939
		Lampides	*Lampides boeticus LINNAEUS, 1767*
		Cupido	*Cupido (Cupido) staudingeri CHRISTOPH, 1873*
		Celastrina	*Celastrina argiolus argiolus* LINNAEUS, 1756
		Chilades	*Chilades trochylus trochylus* FREYER, 1845
		Plebeius	*Plebeius (Plebejides) pylaon turcmenicus* Forster, 1936
			Plebeius (Plebeius) christophi christophi STAUDINGER, 1874
			Plebeius (Vacciniina) morgianus KIRBY, 1871
			Plebeius (Plebejidea) loewii ZELLER, 1847
			Plebeius (Kretania) eurypilus eurypilus FREYER, 1851
			Plebeius (Aricia) agestis [DENIS & SCHIFFERMULLER], 1775
		Polyommatus	*Polyommatus (Polyommatus) amandus amandus* SCHNEIDER, 1792
			Polyommatus (Polyommatus) thersites CANTENER, 1835
			Polyommatus (Polyommatus) icarus Rottemburg, 1775
			Polyommatus (Meleageria) daphnis [DENIS &SCHIFFERMULLER], 1775
			Polyommatus (Lysandra) bellargus ROTTEMBURG, 1775
			Polyommatus (Agrodiaetus) caeruleus STAUDINGER, 1871
			Polyommatus (Agrodiaetus) transcaspicus transcaspicus HEYNE, [1895]
			Polyommatus (Agrodiaetus) elbursicus FORSTER, 1956
			Polyommatus (Agrodiaetus) pseudoxerxes FORSTER, 1956
			Polyommatus (Agrodiaetus) xerxes STAUDINDER, 1899
			Polyommatus (Agrodiaetus) posthumus CHRISTOPH, 1877
			Polyommatus (Agrodiaetus) erschoffii LEDERER, 1869
	NYMPHALIDAE	*Limenitis*	*Limenitis reducta reducta* STAUDINGER, 1901
		Vanessa	*Vanessa atalanta atalanta* LINNAEUS, 1758
			Vanessa cardui LINNAEUS, 1758
		Aglais	*Aglais urticae turcicae* STAUDINGER, 1861
		Polygonia	*Polygonia c-album* LINNAEUS, 1758
		Melitaea	*Melitaea phoebe* [DENIS & SCHIFFERMULLER], 1775
			Melitaea arduinna ESPER, 1783
			Melitaea (didyma) persea KOLLAR, 1849
			Melitaea (didyma) interrupta KOLENATI, 1846
		Argynnis	*Argynnis (Pandoriana) pandora Pandora* [DENIS & SCHIFFERMULLER], 1775
			Argynnis (Mesoacidalia) alexandra MENETRIES, 1832
			Argynnis (Fabriciana) niobe ALPHERAKY, 1881
		Issoria	*Issoria lathonia* LINNAEUS, 1758
		Libythea	*Libythea celtis celtis* LAICHARTING, 1782
		Danaus	*Danaus (Anosia) chrysippus chrysippus* LINNAEUS, 1758
		Lasiommata	*Lasiommata megera transcaspica* STAUDINGER, 1901
		Coenonympha	*Coenonympha saadi* KOLLAR, 1849
			Coenonympha pamphilus LINNAEUS, 1758
		Maniola	*Maniola jurtina phorima* FRUHSTORFER, 1909
		Hyponephele	*Hyponephele wagneri* HERRICH-SCHAFER, 1846
			Hyponephele comara LEDERER, 1871
			Hyponephele amardaea LEDERER, 1869
			Hyponephele cadusia cadusia LEDERER, 1869
			Hyponephele lycaonides WEISS, 1978
			Hyponephele lupina intermedia STAUDINGER, 1886
		Proterebia	*Proterebia afra FABRICIUS, 1787*
		Melanargia	*Melanargia russiae russiae ESPER,1783*
			Melanargia evartianae WAGENER, 1976
			Melanargia larissa hylata MENETRIES, 1832
		Satyrus	*Satyrus parthicus LEDERER, 1869*
			Satyrus iranicus SCHWINGENSCHUSS, 1939
		Hipparchia	*Hipparchia turcmenica HEYDEMANN, 1942*
			Hipparchia fatua persicana VERITY, 1937
			Hipparchia parisatis KOLLAR, 1849
		Chazara	*Chazara briseis meridionalis STAUDINGER, 1886*
			Chazara persephone transiens ZERNY, 1932
			Chazara bischoffi HERRICH-SCHAFFER, 1882
		Pseudochazara	*Pseudochazara beroe aurantiaca STAUDINGER, 1871*

			Pseudochazara schakuhensis schakuhensis STAUDINGER, 1881
			Pseudochazara pelopea persica CHRISTOPH, 1877
			Pseudochazara thelephassa GEYER, 1827
HESPERIIDAE	HESPERIOIDEA	*Thymelicus*	*Thymelicus lineola* OCHSENHEIMER,1808
		Hesperia	*Hesperia comma pallida* STAUDINGER, 1901
		Ochlodes	*Ochlodes venatus faunus* TURATI, 1905
			Ochlodes hyrcana CHRISTOPH, 1893
		Erynnis	*Erynnis marloyi marloyi* BOISDUVAL, 1834
		Carcharodus	*Carcharodus alceae alceae* Esper, 1780
		Spialia	*Spialia orbifer* HUBNER, 1823
		Muschampia	*Muschampia plurimacula* CHRISTOPH, 1893
		Pyrgus	*Pyrgus armoricanus persicus* REVERDIN, 1913

Log scale represents of species have number range of 86 species in the 1-200 individuals range (over 88% of the collected species) to one species (*Polyommatus Icarus*) in the 801-1000 individuals range.

3.2 α-Diversity

Table 2 and Fig1 show that species richness based on Margalef index was unequal among the localities. Syah khani had the highest species richness in the month of June while Behshahr had the lowest one in the month of September. Same was observed for species diversity based on Shannon-Wiener index which was the highest in Syah khani in the month of June and the lowest in Bastam in the month of August (Table 2 and Fig. 2). Also, the species evenness was the highest in Kelateh rudbar in the month of July and the lowest in Gur sefid in the month of May.

Table 2: Species diversity, richness and evenness in spatial dimension

Semnan Province				
Sampling Stations	**Months**	**Margalef**	**Shannon- Wiener**	**Evenness**
Cheshme Ali	**May**	8.621379	0.619663	0.796327
	June	14.81007	0.863634	0.905047
	July	10.66891	0.731312	0.865358
	August	12.49731	0.856935	0.948892
	September	12.64326	0.870513	0.963927
Dibaj	**May**	6.492997	0.50725	0.725711
	June	12.78252	0.849519	0.94068
	July	20.12837	0.977012	0.938178
	August	19.59041	0.990638	0.951263
	September	12.95881	0.835087	0.9247
Tuye Rudbar	**May**	12.69039	0.808024	0.894733
	June	18.1907	0.888925	0.888925
	July	23.84049	1.006022	0.932209
	August	21.75496	1.032305	0.956563
	September	14.16682	0.89229	0.935077
Dashte boo	**May**	8.961956	0.654483	0.841074
	June	12.81648	0.820522	0.859867
	July	26.67227	0.890078	0.739194
	August	19.39519	0.907533	0.871461
	September	10.99505	0.806706	0.954571
Khoshyeylagh	**May**	17.71635	0.856958	0.856958
	June	36.1548	1.13372	0.886582
	July	31.26788	1.091421	0.88701
	August	34.9095	1.084265	0.881195
	September	19.29419	1.136663	1.091484
Syahkhani	**May**	9.911356	0.633671	0.814329
	June	48.24874	1.200369	0.881504
	July	34.35052	1.046363	0.868986
	August	30.129	1.078355	0.895554
	September	15.55586	0.854706	0.895691
Mahdishahr	**May**	15.87085	0.867084	0.867084
	June	31.45365	0.97986	0.813756
	July	23.33379	0.981352	0.880971
	August	21.44329	0.999407	0.926079
	September	22.83102	0.905252	0.838832
Telmadareh	**May**	18.0774	0.899057	0.899057
	June	17.12781	0.965536	0.965536
	July	10.75435	0.752624	0.890576
	August	32.14522	1.07502	0.892785
	September	7.59257	0.663328	0.852441

Gursefid	**May**	16.08638	0.598553	0.554636
	June	9.09772	0.643782	0.827322
	July	18.0618	0.923087	0.886397
	August	29.06187	0.973623	0.849489
	September	12.82756	0.822613	0.910887
Kelateh Rudbar	**May**	7.169567	0.677792	0.969701
	June	9.264408	0.787637	0.932007
	July	11.10755	1.092845	1.293158
	August	8.701813	0.707324	0.90898
	September	3.691347	0.578295	0.960527
Semnan Province				
Sampling Stations	**Months**	**Margalef**	**Shannon- Wiener**	**Evenness**
Gardane Ahovan	**May**	7.083408	0.673561	0.963648
	June	17.32394	0.772997	0.742272
	July	9.111084	0.782094	0.925448
	August	10.24542	0.762972	0.902821
	September	10.83708	0.694371	0.821645
Bastam	**May**	8.621379	0.684304	0.879397
	June	12.39596	0.732058	0.810615
	July	12.59538	0.678796	0.751637
	August	4.51545	0.402564	0.668644
	September	4.921796	0.601654	0.860772
Damghan	**May**	9.346159	0.635582	0.816785
	June	8.85426	0.743517	0.955492
	July	10.95645	0.754792	0.893141
	August	12.69039	0.826701	0.915414
	September	8.217263	0.561554	0.721651
Firuzkuh	**May**	5.115014	0.6725	0.96213
	June	7.385606	0.763325	0.980947
	July	15.87085	0.878355	0.878355
	August	16.03457	0.875166	0.917132
	September	6.9897	0.73723	0.947412
Namrud	**May**	4.81648	0.634709	0.908063
	June	18.96703	0.852187	0.789661
	July	9.478702	0.785581	0.929574
	August	8.054536	0.781145	0.924325
	September	7.531635	0.753988	0.89219
Behshahr	**May**	4.140634	0.481292	0.799409
	June	3.966658	0.543287	0.90238
	July	3.528274	0.591703	0.982797
	August	4.24492	0.53179	0.883284
	September	1.80618	0.42314	0.886861
Sari	**May**	4.455773	0.576274	0.824462
	June	5.369691	0.653276	0.934627
	July	5.520845	0.66502	0.951429
	August	4.165571	0.671679	0.960955
	September	6.688391	0.481034	0.688204
Kyasar	**May**	7.156819	0.573229	0.736655
	June	19.95309	0.977964	0.87793
	July	23.30109	1.034287	0.902418
	August	17.16003	0.897004	0.86135
	September	4	0.590309	0.844541
Kandovan Tunnel	**May**	7.22472	0.822853	0.973678
	June	11.45091	0.898714	0.941809
	July	35.68088	1.127106	0.88141
	August	18.9574	0.984113	0.88345
	September	18.29034	0.975287	0.903729
Veresk	**May**	4.027268	0.586847	0.974732
	June	10.58057	0.757829	0.896735
	July	18.75061	0.95028	0.912509
	August	21.99011	1.037006	0.930932
	September	12.98599	0.833592	0.873564

Syah khani station showed highest Margalef index in the month of June, and Behshahr station showed lowest value in the month of September (Fig1). Syah khani station showed the highest Shannon- Wiener value in the month of June, and Bastam station showed lowest Shannon- Wiener value in the month of August (Fig2).As for the species evenness, the maximum and minimum values were seen in Kelateh Rudbar in the month of July and Gursefid in the month of May, respectively (Fig. 3).

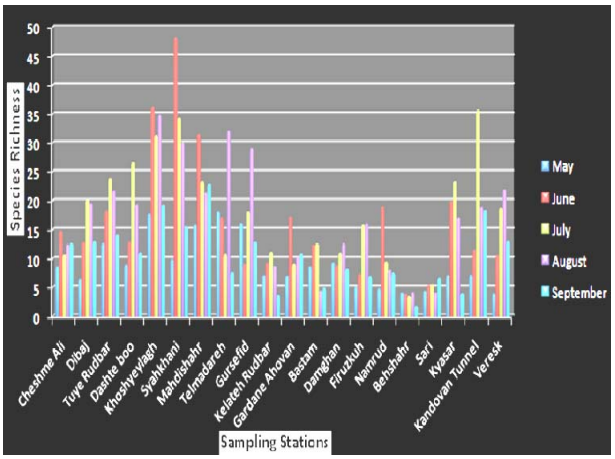

Fig 1: Margalef index (D_{mg}) in spatial and temporal dimensions in all sampling sites.

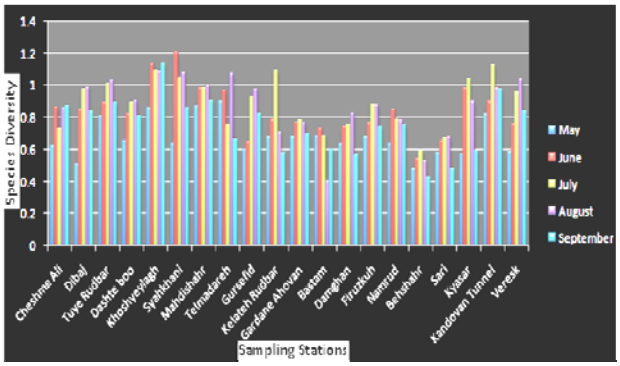

Fig 2: Shannon- Wiener in spatial and temporal demensions in all sampling sites.

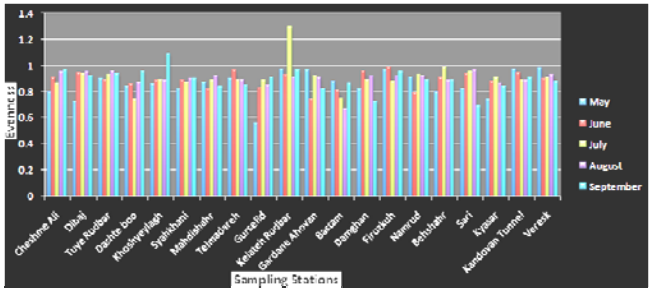

Fig 3: Evenness index in spatial and temporal demensions in all sampling sites.

3.3 B-Diversity

i) Ubiquity; In the present study, Kelateh rudbar in Semnan province, with higher distribution of the set of species, was more widespread transect, P= 0.78; and Syah khani, in Semnan province, with lower distribution of the set of species, was the more restricted transect, P= 0.26875; thereby showing that the species which were found in Kelateh rudbar were most common than species of other locality.

ii) Similarity; Kelateh rudbar and Cheshme Ali indicated more similarity in species composition. On the other hand Behshahr and Syah khani showed more dissimilarity in context of species composition (Fig.4).

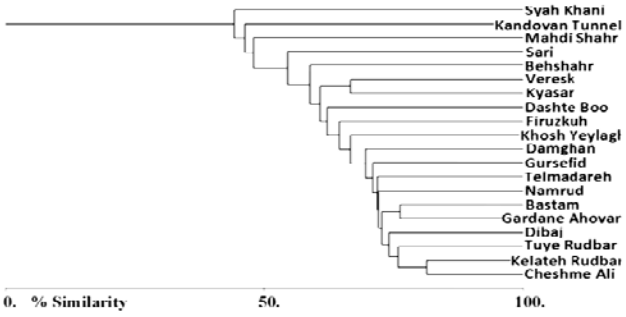

Fig 4: Similarity of species composition amongst all Sampling Stations.

4. Discussion

Taxonomic classification is an imperative measure for preparing inventory of any fauna and flora. The collected speciments were fixed and identified with the help of keys available in the book "Butterflies of Iran" [7]. The study resulted in record of 96 species of Butterflies belonging to 2 super families, 8 families, 12 Subfamilies and 45 Genera from twenty different localities of two provinces. 4 of 20 sampling plots were intact stations where nobody else had conducted survey before; i.e., Dashte boo, Telma dareh, Kelateh Rudbar and Syah khani. The study represents almost 24% of the total Iranian butterfly fauna. All the five families of Butterflies which have been recognized in Iran were present in the present samples. The results presented here are an effort of sampling over a period of just six months. As it has been already mentioned because of low temperature no butterfly could be seen during autumn, winter and the first days of spring. Every locality was visited once per month during these six months. The number of species found at different collection sites ranged from 7-41. *(Numbers in parantheses indicate species recorded).* High number of butterfly species recorded at some sites was due to the good weather conditions and also favorable nectar plants which are most preferable for butterflies.

The family NYMPHALIDAE was the most diverse with 19 genera (*Limenitis, Vanessa, Aglais, Polygonia, Melitaea, Argynnis, Issoria, Libythea, Danaus, Lasiommata, Coenonympha, Maniola, Hyponephele, Proterebia, Melanargia, Satyrus, Hipparchia, Chazara* and *Pseudochazara*) and 41 butterfly species. Amongst 19 genera, genus *Hyponephele* (6 species) was best represented, followed by *Melitaea* (4 species), *Pseudochazara* (4 species), *Melanargia* (3 species), *Argynnis* (3 Species), *Hipparchia* (3 species), *Chazara* (3 species), *Satyrus* (2 species), *Vanessa* (2 species), *Coenonympha* (2 species), followed by *Aglais, Polygonia, Issoria, Libythea, Danaus, Maniola, Lasiommata, Proterebia* and *Limenitis* with single species only. Genus *Polyommatus* (12), *Plebeius* (6) and *Hyponephele* (6) were the dominant genera amongst the documented butterflies. These four genera combined amounts to 25% (24/96) of the total documented fauna. Other diverse genera included *Pieris* (5 species), *Colias* (4 species), *Lycaena* (4 species), *Hipparchia*

(3 species), *Chazara* (3 species), *Euchloe* (2 species), *Gonepteryx* (2 species), *Satyrium* (2 species), and *Ochlodes* (2 species). The result of the numbers of genera would be different in different months or seasons as most butterflies are known to occur only at particular time of the year, so precise estimate of butterfly occurrence may not be possible. Most frequently recorded butterflies include *Polyommatus (Polyommatus) Icarus* (20), *Pieris rapae rapae* (19), *Pontia (daplidice) daplidice* (19), *Vanessa cardui* (19), *Colias crocea* (17), *Pieris brassicae brassicae* (15), *Lampides boeticus* (14), *Colias erate erate* (13), *Pieris (napi) pseudorapae* (12) and *Carcharodus alceae alceae* (12).

Sampling sites included Desert, Hill, Grove, Mountains and Seaport. Some of the species were found in all these geographical types (for example: *Polyommatus (Polyommatus) Icarus*) and some of them were just endemic for a special climate or a certain geographical area. The results of our study regarding habitat preference shows that out of 96 species, 37 species (39%)were found in Deserts; 47 species (49%) were seen in Hills; 47 species (49%) were observed in Groves; 58 species (60%) were found in Mountainous areas and finally 15 species (16%) were found in Seaports. It meant that our specimens were more widespread in Mountainous sampling sites which were more intact areas and were places with fewer humans; and were rarer in Deserts where there were less or no nectar plants and also not enough water for butterflies to survive. In our survey we found 79 species out of 134 recorded species in Semnan province (59%) and 53 species out of 186 recorded species in Mazandaran province (28.5%).

As opposed to previous reports from Mazandaran province, we could not find more number of species. Our sampling yield was only 53 species almost 28.5% of recorded species of the previous studies. Some factors such as spraying of pesticides and weedicides in farmlands by farmers or tourist activities during the period of our survey could be some cause of low species number. Even at most of our sampling sites we could not find any butterfly. Indeed, the numbers of sampling stations were more than 5 sites in Mazandaran province, but because of the causes which have been already mentioned, no specimen could be found there. So the result of sampling at these stations was "zero" during our sampling period. The result of our survey in Semnan province was more satisfying (79% of recorded species were observed). This is because of the pleasant climate and plenty of favorable nectar plants for butterflies in this province during the period of our survey. In the present study, the species were identified on the basis of morphology (phenotype) and other physical features like coloration of markings of the wings etc.

However taxonomic studies in future with DNA barcoding would reveal interesting results, as in nature there are lot of mimics (Müllerian and Batesian) which could pass off as original species. The scale and momentum of habitat destruction requires ecologists to accept the practical need for quick surveys of biodiversity in ecological monitoring and conservation planning [8]. Butterflies could provide a model system for testing the accuracy of quick biodiversity survey and performing detailed comparisons in spatial and temporal dimensions [3]. As each animal has different needs, so maybe a certain habitat which is desirable for a certain animal is not favorable for the other one. So it is clear that there is record of differences in biodiversity of animals in different habitats. This could be the reason that we can see the high diversity of butterflies in one habitat compared to other habitats. Some observed differences in the selected localities could affect total results, and finally reflecting on increase in butterfly biodiversity. For example, the differences in altitude can lead to the differences in climatic conditions, different climatic conditions can lead to the differences in habitat, and finally, the differences in habitat can lead to the differences in vegetation and insect diversity. Geographic isolation of one habitat caused by altitude differences or mountains can lead to the isolation of some animals as unique species for that habitat [3]. According to the differences mentioned between study areas, the differences observed in butterflies' species richness, diversity, and evenness are expected [9]. Suggested that the ecological factors including altitude, vegetation, and opening grade are important for the distribution of hoverflies. Speight and Castella [10], reported that there were more species of hoverflies in the localities with differences in ecological factors than in the homogenous habitats i.e. vineyards. The presence of heterogeneous fauna around agricultural ecosystems is an important factor for the presence of different species of butterflies [3]. Fisher et al., [11] plotted their data and found that it fitted a "hollow curve", while in our study, 86% of species were represented by fewer than 100 individuals, and 82 rare species had ≤ 100 individuals. Results of our study are in concurrence with the statement that, butterflies could provide a model system for testing the accuracy of quick biodiversity survey and performing detailed comparisons in spatial and temporal dimensions [3]. From the observations of our study, we could see the relative increase in species richness and diversity from mid-June till the end of July, which is the best optimal time, with features such as higher temperature, vigorous growth and flowering of most flowering grassy plants (Fig. 1). As the day temperature increased we could find growth of desired nectar plants. So we could capture more butterflies, resulting in the decrease of species evenness in the month of September. The observed relative decrease in species evenness could be due to increase in the abundance of butterflies, which makes distortion in population shape (Fig. 3). In addition a decrease was seen in the species richness in May, which is the result of the cold weather and reduction in flowers of flowering plants, the suitable hosts for butterflies. A decrease in the species diversity in May also could be due to the low number of appropriate nectar plants (Fig. 2). There were two peaks in the α diversity in Syah khani in Semnan province and Kandovan tunnel in Mazandaran province in context of spatial dimension. The Maximum diversity was observed in Syah khani (Fig.2 and Table 2). Kelateh rudbar and Cheshme Ali (both in Semnan province) indicated more similarity in species composition. The main reason for this could be due to similar geographical features and weather conditions (Fig. 4). On the other hand, Behshahr in Mazandaran province and Syah khani in Semnan province showed more dissimilarity in context of species composition as there were lots of differences between these two stations like altitude and longitude, geography, nectar plants etc. (Fig.4). From the view point of ubiquity, Syah khani and Kelateh rudbar (both in Semnan province) had less and more ubiquity, respectively, as those species which were found in Syah khani station were rarer than the species of Kelateh rudbar station which were almost common in all station . In total we observed more species richness and species diversity in areas with higher altitude. For example, the species variety and species richness were more in Syah khani station in Semnan province, where has higher altitude; and also Behshahr in Mazandaran province with lower altitude had the lower species richness among all sampling sites. We observed more butterflies with variety and richness in areas which were less impacted by human population such as Syah khani with higher value with respect to species richness and species diversity among all sampling sites. In addition we observed

less species and sometimes no species in some stations of Mazandaran province. This could be because of farmlands in the vicinity, as the famers use chemical fertilizers and pesticides. Some of these areas also were near to main roads and human habitations which may be the cause of low numbers of butterfly or no butterfly. Monitoring and mapping biodiversity is the first step in systematic conservation planning [12]. Our study takes the initial stage of documenting biodiversity. We observed that butterfly diversity and abundance changed along the monthly gradient in each landscape type. This could be attributed to few factors such as rainfall, floral composition of symbiotic or related animal species, etc. influencing the ecology of butterfly community. Therefore, our findings are important with respect to monitoring and defining conservation strategies. The result of our field studies and analyses indicates that these provinces have rich biodiversity of butterflies. Therefore, instant measures should be taken to conserve it, before it is eroded by anthropogenic activities. This project was done in a span of one year. Further continuous attempts for collecting data annually especially in more stations will help us to have more complete information about butterflies of these two provinces. So it is strongly recommended that this study should be undertaken by future researchers. Our work strives to serve as a background study for future studies especially with respect to biodiversity.

5. Conclusion

Climate change, rather than direct changes to land use, is likely to be the key driver of recent changes to butterfly diversity in the study system. In addition, the sampling localities with various climatic and geographic conditions yielded different results with reference to the kind of species and their abundance and appearance. Surveying in different months during a year also has added to the value of these results. However, the number of collected Butterflies in the study region is still quite low. It would be desirable if such studies could be done on a regular basis in all provinces of Iran during a year. Then comparing the data will give us interesting results about the differences among various provinces with absolutely different climatic conditions. Some butterflies could be found in some regions during autumn and winter as some places in Iran have higher temperature during these two months also. Results of our study indicated “Syah Khani” with maximum butterfly diversity where human habitation was nil. The butterfly fauna at this sampling site was almost 90% different from month to month of survey. Documentation of such rich diversity from two provinces, Semnan and Mazandaran, Iran, warrants conservation of the habitats that harbor them.

6. Acknowledgment

We appreciate expert comments of Alireza Ghorbanian, Iran; Anand Padhye, India and Hemant Ghate, India. We acknowledge assistance from CAS- Department of Zoology and BCUD, University of Pune, India.

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