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Hospitality of Iranian host plants from butterflies between Caspian Sea and Dasht-e-Kavir territories

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Abstract
Point of this study is to explore impact of biological systems particularly sorts of host plant on life and number of butterflies in particular territories. Butterflies are a gathering of insects which, getting affected by immediate impacts of atmosphere progressions, encounter a risk from different components in the nature, since they are potential bioindicator and one of paramount components of all environments furthermore closely connected with plants. Plants as butterfly's host respond first to the atmosphere changings and afterward to phytophagous insects and adjust themselves corresponding to conditions. In this study, local butterflies and their host plants were inspected once a month in a boundless zone encased among Alborz Mountain Range and Dasht-e-Kavir Desert, North of Iran, in 150 days from May 2009-September 2009. In these areas 65 species of plants belonging to 22 families have been archived, which concurring our results, blooms of family Asteraceae were basically visited by butterflies up to 70 separate butterflies' species, which demonstrates its imperative part in nourishment and survival of visitors, because of overall appropriation in different climate and having a paramount nectar hotspot for grown-up butterflies. Likewise, *Pieris rapae* was most plentiful guest for host plant, i.e. 46 host plant species. Based on this study, we accept that expanding butterflies' number brings about developing different sorts of fauna that feed from this bug and thus leads, enhancing ecosystems and bringing numerous favorable circumstances for individuals which might make arrangements for developing attractive plants in the future.

Keywords: Butterfly, Caspian Sea, Dasht-e-Kavir, Iran, Host plants.

1. Introduction
Soon after mating, the adult female butterfly starts searching for an appropriate food plant to lay eggs. Most butterfly species lay eggs on one or a few select, plant species [1]. Flower species probably differ from each other in shape, size and odour, etc. Thereby insects that have developed the appropriate skills, can feed on them and thus persuades individual insects to stick on the same species and thus carry pollen from one plant to another [2]. Which will help to grow new plants and consequently affects on butterflies and other fauna's number, whose their food are these insects and outcomes in either health of ecosystems or mankind.
It is obvious that chemical and nutritional features of the food substrate determine consumption, development and survival in the larval stage of butterflies and egg production of the adults [3]. Plants with antibiosis mechanism may either decrease directly insect's survival, size or weight, longevity and fecundity of adults or may have an indirect effect by increasing the exposure of the insect to its natural enemies due to prolonged developmental period [4]. There are several reports for butterflies' host plants at different places all over the world; while, few reports have been published about host plants of adult butterflies in particular cases inside of small area in Iran and investigations on host plants of Lepidoptera are still at its infancy in Iran, however some surveys have been already done on other orders of insects like Hemiptera [5, 6, 7], Heteroptera [8], Coleoptera [9, 10]. In Mazandaran province, in which some parts of our survey was done, some related surveys have been done on host plants of Heteroptera [11] and also host plants of the particular species of Lepidoptera [12].
In addition some researchers have done surveys on nutritional indices of Lepidoptera on particular host plants [13], the relationship between the host plants and butterfly's size [14] and butterflies reproductive performance and growth indices on various host plants [15]. However, there is still a great need to study all host plants of adult butterflies in vast area

neither on particular species nor on special host plant. So during this project we made an attempt to check out host plants of adult Iranian butterflies in an area enclosed among Alborz Mountain Range and Dasht-e-Kavir Desert, North of Iran. Relatively large numbers of adult species and their host plants were collected and subsequently identified according their feature with help of guidance books. The results of the study are discussed in the context of butterfly species composition and flower visiting of butterflies.

2. Material and Methods

The fieldwork was conducted at twenty sites in the north of Iran, from May 2009 till September 2009, almost 150 days. Every site was visited once a month during this period. Survey sites were accessible open areas of natural habitat usually woodland clearings, scrub or pasture, stratified by elevation and selected to be representative of the main land cover types in the region. Descriptions of each sampling location are mentioned in table 1.

The sampling sites were enclosed by Caspian Sea, Alborz Mountain Range and Dasht-e-Kavir, in North of Iran. The Caspian Sea is the largest inland body of water in the world and accounts for 40-44% of the total lacustrine waters of the world. The drastic changes in climate alongside of the Caspian Sea have led to a great deal of biodiversity in the region.

Mount Damavand, Iran's tallest mountain, is located in the Alborz mountain rangeand in the Middle East. Alborz mountain range in northern Iran is bordered between Azerbaijan and Armenia in the northwest, the southern end of the Caspian Sea, Turkmenistan and Afghanistan in the east.

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, with 800 km (497 mi) length and 320 km (198 mi) width in a total surface area of about 77,600 square km. it's climate is almost rainless and the area is very arid.

Fig 1: Caspian Sea, Alborz mountain range and Dasht-e-Kavir in Iran map.

Fig 2: Detailed map of sampling sites.

Table 1: Descriptions of each sampling location

Sampling sites	Name of place	Climatic condition	Type of plant coverage	Dominant Plant species
S1	Cheshme Ali	36° 16'N, 54° 05'E, 1500m	Dry deciduous, Evergreen, Riparian, Orchard plants	*Acroptilonrepens* *Cardariadraba* *Descurainiasophia* *Glycyrrhizaglabra*
S2	Dibaj	36° 26'N, 54° 14'E, 1850m	Dry deciduous, Evergreen, Scrub, Grassland, Orchard	*Cardariadraba* *Cirsiumarvense* *Delphinium speciosum* *Melilotus officinalis*
S3	Tuy-e-Rudbar	36° 27'N, 54° 09'E, 1875m	Dry deciduous, Scrub, Grassland, Orchard plants	*Acroptilonrepens* *Anchosairanica* *Irsiumarvenses* *Glycyrrhizaglabra*
S4	Dasht-e-Boo	36° 01'N, 53° 49'E, 1800m	Dry deciduous, Evergreen; Scrub, Riparian, Mixed vegetation, Orchard	*Acroptilonrepens,* *Cardariadraba* *Cercis siliquastrum* *Delphinium speciosum*
S5	KhoshYeylagh	36° 51'N, 55° 21'E, 1740m	Dry deciduous, Semi-evergreen, Scrub, Grassland, Orchard plants	*Aliumcepa* *Anchusairanica* *Arctium lappa* *Cichoriumintybus*
S6	SyahKhani	35° 56'N, 53° 21'E, 2900m	Dry deciduous, Scrub	*Acantholimongulistanum* *Acanthophyllum Caespitosum* *Cercis siliquastrum* *Cirsiumarvense*
S7	Mahdi Shahr	35° 42'N, 53° 21'E, 1680m	Dry deciduous, Evergreen, Scrub, Grassland, Orchard plants	*Achillea biebersteinii* *Achillea millefolium* *Acroptilonrepens* *Centaura pulchella*
S8	Telmadareh	36° 13'N, 53° 43'E, 1661	Dry deciduous, Scrub, Grassland, Orchard plants	*Centaureasintenisiana* *Acroptilonrepens* *Anchosairanica* *Centaureaalbursensis*
S9	GurSefid	35° 43'N, 53° 01'E, 2395m	Dry deciduous, Scrub, Grassland	*Arctiumlappa* *Cirsiumarvense* *Malva microcarpa* *Medicagosativa*
S10	KelatehRudbar	36° 21'N, 54° 08'E, 1640m	Dry deciduous, Scrub, Grassland, and Orchard	*Cardariadraba* *Centaura pulchella* *Delphinium speciosum* *Descurainiasophia*
S11	GardanehAhova	35° 48'N, 53° 51'E, 1710m	Dry deciduous, Scrub, Grassland, and Orchard plants	*Acroptilonrepens* *Cardariadraba* *Centaura pulchella* *Convolvulus arvensis*
S12	Bastam	36° 29'N, 55° 00'E, 1410m	Dry deciduous, Scrub, Teak plantation, Grassland, and Orchard	*Acroptilonrepens* *Cichoriumintybus* *Galium aparine* *Lycumpersicum*
S13	Damghan	36° 10'N, 54° 21'E, 1170m	Dry deciduous, Evergreen, Scrub, Grassland, and Orchard	*Acroptilonrepens* *Mentha aquatica* *Medicagosativa* *Triticumsativum*
S14	FiruzKuh	35° 43'N, 53° 01'E, 2395m	Dry deciduous, Evergreen, Scrub, and Grassland	*Achillaaucheri* *Arctiumlappa* *Cirsiumarvense* *Descurainiasophia*
S15	Nam Rud	35° 15'N, 52° 38'E, 990m	Dry deciduous, Scrub, Grassland plants.	*Achillea biebersteinii* *Acroptilonrepens* *Cardariadraba* *Medicagosativa*
S16	Behshahr	36°41'N, 53°32'E, 20 m	Moist deciduous, Evergreen, Riparian, Orchard	*Erucasativa* *Senecioiranicum* *Medicagosativa* *Descurainiasophia*
S17	Kyasar	36º14´N, 53º32´E, 1280 m	Dry deciduous, Evergreen, Riparian, Mixed vegetation, Orchard	*Senecioiranicum* *Medicagosativa*

				Cirsiumarvense
				Trifolium alexandrinum
S18	Sari	36°.33'N, 53°03'E, 25 m	Dry deciduous, Evergreen, Riparian, Paddy, Orchard	*Erucasativa*
				Cirsiumarvense
				Senecioiranicus
				Medicagosativa
S19	Veresk	35º53´N, 52º59´E, 2140 m	Dry deciduous, Scrub plants	*Taraxacum iranicum*
				Sambucus ebulus
				Arctium lappa
S20	Kandovan Tunnel	36º09´N, 51º19´E, 2670 m	Dry deciduous, dense species-rich vegetation abundant flower, low trees and bushes	*Descurainiasophia*
				Centaurea pullchella
				Senecioiranicum
				Euphorbia aucheri

Butterflies sampling was done in 4-5 times around every sampling site; in approximately 700 m length by an hour walking at a constant pace. 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 so.

In the survey, diurnal 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). Remarkable numbers of butterflies were killed by pressing their chest. All of them now are available in our personal collection. Temperature range was between 8.1 ^{0}C in Sari to 29.8 ^{0}C in Damghan in August; and humidity range was between 16% in Gardan-eAhovanto 80% in Kyasar in July. The highest altitude is belonged to SyahKhani site (2900 m); and the lowest altitude to Behshahr region (20 m a.s.l.).

Taxonomic identification of the host plants was done by using in the book "Dictionary of Iranian plant, 1998" by Mozaffarian, V., with the help of Mr. Alireza Ghorbanian, Iranian botanist in Azad university of Damghan branch.

3. Results and Discussion

Visited flower was not quantified, but noted for each plant visited by adult butterflies in the study plots. Thus, host flower of butterflies could be observed in 65 different plant species belonging to 22 plant families.

The most important plant family visited was of Asteraceae, with up to 70 different butterflies species, of whereas *Acroptilonrepens*, was visited by 44 different butterfly species. *Cirsiumarvense* of the family Asteraceae was visited by 43 butterfly species. Most butterflies were only observed visiting flowers of a limited number of plant species. But host plants belonging to the four plant families i.e. Adoxaceae, Amaryllidaceae, Rubiaceae and Tamaricaceae were visited by just one butterfly species (Table 2). Butterflies are visiting a wide range of flowers (up to 46 host plant species) which has been shown in Table (3). While, those have been just attracted to one host plant were 22 butterflies species from 96 collected species (Table 4).

In addition, some butterflies species were observed on the ground or on rubbish; *Hyponephele wagneri* which was found on the ground, also was seen resting on *Cirsiumarvense* of the family Asteraceae; and *Hipparchia parisatis* which was found on the ground and on the rubbish also.

Various host plants can affect life history traits of the insects such as development, survival and reproductive rates [16], and have main role in regulating insect populations [17]. The shorter developmental time and greater total reproduction of insects on a host plant indicate greater suitability of that plant [18].

Variation in the quantity and quality of food eaten by an insect can also affect its growth, reproduction, diapauses and migration [19]. It is an advantage for the pollinator to have its own "private" food source due to less competition. The varied shapes, colours, and odours of flowers allowed their recognition by pollinators and excluded unwanted, indiscriminate pollinators [20].

There are a number of reports on butterfly host plants of Europe and the United States [21]. Studies of Scott [22] with butterflies of North America are in concurrence with our observations that more butterflies visited the flowers of family Asteraceae. (No such studies have been conducted on host plants of adult butterflies of Iran in such a vast area).

The prominent feature of our study was that all sampling plots were wilderness areas where all plants grew by their own. So butterflies species had vast option in selecting their host plants. But if we can plant more desirable host plants for butterflies then it can invite more species of butterflies to those plants.

Table 2: The less visited Host plants

Host plant Family	Only visitor/ Butterfly species
Adoxaceae	*Issoria lathonia*
Amaryllidaceae	*Vanessa cardui*
Rubiaceae	*Polyommatus (Polyommatus) icarus*
Tamaricaceae	*Cigaritisepargyros*

Table 3: Butterflies visiting a wide range of host plants

Butterfly Species	Number of Visited Host plants(out of 65 Host plant Species)
Pieris rapae rapae	46
Coliascrocea	45
Pontiadaplidice	44
Vanessa cardui	44
Polyommatusicarus	43
Pierisbrassicae	33
Lampidesboeticus	30

4. Conclusion

In general, according the results host plants of family Asteraceae were visited by the most butterfly species which shows the importance of this family in nutrition and survival of various butterfly species. However some butterflies visited the less number of host plants or even just one host plant (23 butterfly species). What we are thinking is that:

1. With studying the desirable host plants, programming to grow them, can attract special butterfly species to the certain area
2. Attraction of butterflies affects on improvement of food chain or even total ecosystem of the region.

3. Improving life condition for all creature especially humans.

The number of collected butterflies in the studied region is still quite low and we expect that longer observations would yield several additional species. In addition, investigations on butterfly host plants are still at its infancy in Iran, however some works have been done on caterpillar host plants earlier [23]. Extensive studies are needed to check the existing collections because it is well possible that rare and difficult species have been overlooked so far. It becomes imperative to study butterfly choice or option for host plants in the light of conservation efforts.

Table 4: Host plants observed for each butterfly Family.

Host plant	**Butterfly Family**						
Plant Family	**Plant Species**	**PAPILIONIDAE**	**PIERIDAE**	**LYCAENIDAE**	**NYMPHALIDAE**		**HESPERIIDAE**
Adoxaceae	*Sambucus ebulus*	0	0	0	1	0	**1**
	Sambucus nigra	0	0	0	1	0	**1**
	Sambucus ebulus	0	0	0	1	0	**1**
Amaranthaceae	*Amaranthus viridis*	1	0	0	0	0	**1**
	Chenopodium album	0	7	5	2	1	**15**
	Salsola tomentosa	0	0	1	0	0	**1**
Amaryllidaceae	*Allium cepa*	0	0	0	1	0	**1**
Asteraceae	*Achillea aucheri*	1	5	2	2	0	**10**
	Achillea biebersteinii	0	4	4	2	1	**11**
	Acroptilonrepens	1	9	13	19	2	**44**
	Anthemis brachystephana	0	5	4	6	4	**19**
	Arctium lappa	0	6	5	14	2	**27**
	Centaurea albursensis	1	4	1	1	0	**7**
	Centaura pulchella	0	4	3	3	0	**10**
	Centaureasintenisiana	1	4	1	1	0	**7**
	Cichoriumintybus	0	5	1	2	0	**8**
	Cirsiumarvense	1	8	10	22	2	**43**
	Cirsium canum	1	6	2	2	1	**12**
	Senecioiranicum	0	7	4	12	1	**24**
	Senecio racemosus	0	0	1	0	0	**1**
	Taraxacum iranicum	0	4	0	2	0	**6**
	Tragopogongraminifolius	0	4	0	0	0	**4**
	Tragopogon percicum	1	4	4	3	0	**12**
	Xanthium spinosum	1	6	4	7	1	**19**
Boraginaceae	*Anchusa iranica*	0	5	4	5	1	**15**
	Myosotis refracta	0	4	2	2	0	**8**
Brassicaceae	*Alyssum repens*	0	2	2	1	0	**5**
	Anchusa iranica	0	0	1	0	0	**1**
	Cardariadraba	0	6	11	8	2	**27**
	Capsella bursa – pastoris	0	0	1	0	0	**1**
	Descurainia sophia	0	7	9	8	1	**25**
	Erucasativa	0	6	3	2	0	**11**
	Rapistrum rugosum	0	2	0	0	0	**2**
	Sinapis arvensis	0	2	3	1	1	**7**
	Sisymbrium officinale	0	5	4	1	0	**10**
Caryophyllaceae	*Acanthophyllum caespitosum*	0	1	7	9	2	**19**
Convolvulaceae	*Convolvulus arvensis*	0	5	5	4	2	**16**
Euphorbiaceae	*Euphorbia aucheri*	0	2	1	4	0	**7**
Fabaceae	*Glycyrrhizaglabra*	0	6	2	1	0	**9**
	Medicagosativa	1	7	18	5	6	**37**
	Melilotus officinalis	0	5	1	1	0	**7**
	Onobrychis persica	0	1	0	1	0	**2**
	Sophorapachycarpa	0	0	1	1	0	**2**
	Trifolium alexandrinum	1	6	6	15	3	**31**

	Trifolium repens	0	3	2	0	1	**6**
Ixioliriaceae	*Ixioliriontataricum*	0	2	1	1	0	**4**
Lamiceae	*Lamium album*	0	4	1	0	0	**5**
	Menthaaquatica	0	3	7	4	0	**14**
	Menthalongifolia	0	6	2	2	0	**10**
	Menthapiperita	1	6	4	9	2	**22**
	Nepetaamoena	0	4	2	3	0	**9**
	Ocimumbasilicum	0	3	1	0	0	**4**
	Stachyspersica	0	4	8	2	1	**15**
Malvaceae	*Malvamicrocarpa*	0	5	1	1	0	**7**
	Malvaneglecta	0	4	5	3	1	**13**
	Thymus eriocalyx	0	3	6	1	1	**11**
Poaceae	*Triticumaestivum*	0	1	1	1	0	**3**
Polygonaceae	*Polygonumalpestre*	0	2	1	0	0	**3**
Plumbaginaceae	*Acantholimongulistanum*	0	8	4	10	1	**23**
Ranunculaceae	*Delphinium speciosum*	0	6	2	2	0	**10**
Rosaceae	*Rubushyrcanus*	0	2	0	0	0	**2**
Rubiaceae	*Galiumaparine*	0	0	1	0	0	**1**
Scrophulariaceae	*Verbascumflavidum*	0	1	1	0	1	**3**
Tamaricaceae	*Tamarixdeserti*	0	0	1	0	0	**1**
Verbenaceae	*Verbena officinalis*	1	0	0	2	0	**3**

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