Diversity of Hoverflies (Diptera, Syrphidae) in Darab damask rose rain-fed plain, Fars province, Iran

Abbas Mohammadi-Khoramabadi1, Abulfazel Dousti2 & Babak Gharaei3

Abstract. Diversity, community structure, and estimation of flower fly species richness (Diptera: Syrphidae) were measured in Darab damask rose plain, Fars province, Iran. Four Malaise traps were installed in a nearly 500-hectare site from April to October 2019 and checked periodically. The 4-step integrated approach was used to assess the sample completeness profile, to infer true diversities of entire assemblages, to standardize the sample coverage, and to infer diversity via an evenness profile. To estimate the species richness of the Syrphidae community, two models and seven non-parametric indices were used. As a result, a totally of 96 specimens representing 18 species were collected in 18-Malaise trap months (MTM) sampling efforts. One species, *Paragus auritus* Stuckenberg, 1954 was recorded for the first time from Iran. The aphidophagous hoverflies included 76.3% of all collected specimens. The dominant species were *Sphaerophoria scripta* (Linnaeus, 1758), *Eupodes corolla* (Fabricius, 1794), and *Eumerus ahmadii* Barkalov & Gharali, 2004. The estimated sample completeness profile showed that our data covers 85% of the total species in this community. Shannon and Simpson diversity indices are measured at 10.88 and 7.04, respectively. The models and non-parametric estimators estimated the species richness of syrphids varied from 19 – 24 species. The biodiversity of Syrphidae community in the world’s largest rain-fed organic damask rose plain, located at high altitudes of ca. 2600 m a.s.l. of the Zagros Mountains ranges in the south of Iran, provides fundamental data for any future conservation efforts of pollinators and predators and biocontrol programs of sucking pests.

Keywords: Community structure, conservation, Syrphidae, rarefaction

Introduction

Hoverflies or flower flies (Diptera, Syrphidae) with more than 6300 extant species have been known as a highly diverse dipteran family and an essential component of ecosystems (Skevington et al., 2019). Adults effectively pollinate plants while their larval stage harbours a great variety of habitats and feeding modes including predation of hemipteran sternorrhyncha (subfamilies Syrphinae and Pipizinae), saprophagy, phytophagy (subfamily Eristallinae), and association with ants (subfamily Microdontinae) (Dunn et al., 2020). Due to the aphidophagy behaviour of syrphids, they are considered valuable biological candidate agents for controlling aphid pests in agricultural ecosystems (Jalilian et al., 2011; Amiri-Jami & Sadeghi-Namaghi, 2014; Farsi et al., 2014; Földesi & Kovács-Hostyánszki, 2014; Jalilian, 2015; Bellefeuille et al., 2019; Farsi et al., 2020; Irvin et al., 2021; Karimi & Madadi, 2021; Jiang et al., 2022; Radev, 2022). Furthermore, their sensitivity to agricultural practices, widespread distribution and heterogeneity of larval habitat and food

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requirements make them important bioindicators (Sommaggio & Burgio, 2014; Popov et al., 2017; Montoya et al., 2021).

Species of Syrphidae of Iran include 269 valid species distributed in 70 genera and four subfamilies (Dousti, 2023). Documents show that flower flies richness and abundance are under threat and declining due to climate change or human disturbances (Biesmeijer et al., 2006; Chisausky et al., 2020; Barendregt et al., 2022). Therefore, there is a need to expand and document the community structure, abundance and diversity indices of flower flies, and biodiversity data in both natural and agricultural ecosystems (Mehrabi et al., 2006; Bedoreh et al., 2010; Ahmadian & Pashaei Rad, 2011; Kazerani, 2012; Jabbari et al. 2013; Naderloo & Pashaei Rad, 2014; Shayeghi et al., 2014; Babaei et al., 2016; Jalilian, 2019; Zarei Sarchogha et al., 2019; Robertson et al., 2020) for any future ecological studies, conservation efforts and biological control programs (Jabbari et al., 2018; Milić et al., 2019; Gaytán et al., 2020; Montoya et al., 2021; Demirözer et al., 2022; Georgi et al., 2023).

In the south of Iran, Fars province, Darab County, the damask rose, *Rosa damascena*, has been traditionally cultivated almost organically under rain-fed conditions in the high altitudes of Zagros mountain ranges, covering more than 5300 hectares. This area is known as the world’s largest damask rose rain-fed plain (Ebadzadeh et al., 2018). However, this ecosystem is facing human pressure for development through changes in land use, which are impacting the natural *Juniperus-Amigdalus-Pistacia* vegetation type. Concerns also exist regarding rose pest outbreaks (Mehrparvar et al., 2017; Nematollahi, 2018) necessitating the spreading of chemical pesticides and human interventions. A project was conducted in 2019 to investigate the diversity of various insect groups in this region (Mohammadi-Khoramabadi & Khayrandish, 2021; Mohammad-Khoramabadi, 2023). This study focuses on the diversity of hoverflies (Diptera: Syrphidae) caught by Malaise traps in Darab Damask Rose Plain, providing fundamental data for future research by describing the community structure and estimating the maximum species richness of syrphids in this plain.

**Materials and methods**

**Study area and sampling procedure.** This research was conducted in Darab damask rose rain-fed plain (28° 41'N, 54°53'E), Fars province, located in the southern region of Iran, with an altitude ranging from 2570 to 2650 m a.s.l. during the year 2019 (April-October) (Fig. 1A). To effectively capture Syrphidae, a combination of pan trapping, plot observation, hand netting and Malaise trapping was recommended (Gaytán et al., 2020; Robertson et al., 2020). However, due to logistic constraints and the availability of roads, an approximately 500-hectare site was chosen. Four Malaise traps were installed within this area, all aligned on a north-south axis, as depicted in Figure 1B. The specific coordinates of the traps were as follows: T1: 28°42'01"N, 54°54'13"E, 2615 m a.s.l.; T2: 28°42'15"N, 54°54'14"E, 2641 m a.s.l.; T3: 28°41'27"N, 54°55'21"E, 2571 m a.s.l.; T4: 28°42'38"N, 54°53'17"E, 2646 m a.s.l. The containers of traps were filled with 70% ethanol (about 1 litre) as the killing and preservation medium. Traps were checked biweekly, to ensure the accurate collection of specimens. Containers were wrapped in aluminium sheets to minimize alcohol evaporation. Unfortunately, Malaise traps T3 and T4 were destroyed during April and May, resulting in a total sampling effort of 18 Malaise trap months (MTM), a convenient expressed term (Gómez et al., 2017).

**Sample processing, species mounting, and identification.** All Syrphidae specimens were pinned and identified to the species level based on the morphological and genital characters by the junior authors. Seven species were not identifiable but were considered as distinct morphospecies, and included in all statistical analyses. The voucher specimens were deposited in the Insect Museum of Darab College of Agriculture and Natural Resources, Shiraz University.

**Statistical analysis.** The relative abundance (D) of each species was calculated as:

\[ D = \frac{b}{a} \times 100 \]

Where, \( b \) = number of the individuals of the species and \( a \) = number of the individuals of all species. The dominance class of each species was determined using Engelmann's (1978) procedure, with categories including Eudominant (Eu): species with over 32 – 100% of all collected individuals; Dominant (Do): 32 – 10%; Subdominant (Sd): 10 – 3.2%; Recedent (Re): 3.2 – 1%; Subrecedent (Sr): 1 – 0.32%; and Sporadic (Sp): less than 0.32% of all individuals.
Fig. 1. Map of the study area and Malaise trap locations. A. Darab Damask Rose Plain, Fars province, Iran; B. Location of Malaise traps (T1-T4); C. Overall vegetation; D. An installed Malaise trap in the field.

Fig. 2. Habitus of hoverflies in Darab Damask Rose Plain, 2019. A. *Episyrphus balteatus* (De Geer, 1776); B. *Eupeodes corollae* (Fabricius, 1794); C. *Ischiodon aegyptius* (Wiedemann, 1830); D. *Melanostoma mellinum* (Linnaeus, 1758); E. *Sphaerophoria scripta* (Linnaeus, 1758); F. *Eumerus* sp.; G. *Scaeva albomaculata* (Macquart, 1842); H. *P. azureus* Hull, 1949; I. *Paragus auritus* Stuckenberg, 1954; J. *Paragus* sp.

An integrated approach based on the framework of Hill numbers, proposed by Chao *et al.* (2020), was used. This approach includes a four-step analysis to assess sample completeness based on incomplete abundance and incidence data to compare diversity and evenness among assemblages. The sample completeness (*q* = 0), the detected and undetected species (*q* = 1) and the detected highly abundant species (*q* = 2) were assessed in step 1. Step 2, involved size-based rarefaction and extrapolation analysis to estimate the
asymptotic diversity for species richness ($q = 0$), Shannon diversity ($q = 1$), and Simpson diversity ($q = 2$), the three most widely used diversity indices. Step 3 standardized sample coverage is standardized for any fair comparisons among communities and finally step 4 computed the evenness profile for the Maximum standardized coverage $C_{\text{max}}$, for diversity orders $0 < q \leq 2$ (https://chao.shinyapps.io/inext_4steps). The confidence interval obtained from the bootstrap method with 100 replications was 95%.

Non-parametric/Model estimators. Species richness of the Syrphidae community and seven non-parametric estimators were calculated by an online statistical software, SPADE (Species Prediction and Diversity Estimation) available at: https://chao.shinyapps.io/SpadeR (Chao & Shen, 2016). Non-parametric estimators included: Homogenous, Homogenous (MLE), of Chao1, Chao1-bc, iChao1, ACE (Abundance-based Coverage Estimator), ACE-1, 1st order jackknife, and 2nd order jackknife. The confidence interval was similar to the other analysis.

Results
In this study, 44 collecting jars of malaise traps were examined, revealing that 14 of them contained a total of 97 syrphid specimens. These specimens belonged to 18 species from two subfamilies, namely Syrphinae and Eristalinae. The Syrphinae subfamily includes species: Episyrphus (Episyrphus) balteatus (De Geer, 1776), Eupeodes (Metasyrphus) corollae (Fabricius, 1794)*, Ischiodon aegyptius (Wiedemann, 1830)*, Melanostoma mellinum (Linnaeus, 1758)*, Paragus (Paragus) auritus Stuckenberg, 1954**, P. azureus Hull, 1949*, P. bicolor (Fabricius, 1794), P. competitus Wiedemann, 1830*, P. quadrifasciatus Meigen, 1822*, Paragus sp., Scaeva ibomaculata (Macquart, 1842), S. latimaculata (Brunetti, 1923)*, Sphaerophoria bengalensis Macquart, 1842*, S. scripta (Linnaeus, 1758). The Eristalinae subfamily includes: Eumerus ahmadii Barkalov & Gharali, 2004, and Eumerus sp. (3 species) (Fig. 2). Notably one species is recorded for the first time from Iran while eight species are newly recorded from Fras province which are marked with two and one asterisks, respectively.

These species were grouped into two trophic groups, aphidophagous species of the subfamily Syrphinae and saprophagous ones from the subfamily Eristalinae. The aphidophagous hoverflies constituted 76.3% of all collected individuals. Sphaerophoria scripta was the most abundant species, followed by E. corollae and E. ahmadii (Table 1).

Assessment of sample completeness profile (Step 1) (Fig. 3a, Table 2)
The sample completeness profile (Fig. 3a) indicates that at $q= 0$, numerous syrphid species are detectable. Our data sampling encompasses 85% of the total species within this community leaving approximately 15% undetected. Among the detected and undetected species, they represent 95% and 5% of this community's individuals at $q = 1$ (95%), respectively. Notably, almost all of the highly abundant Syrphidae species are detected ($q = 2, 99.9\%$).

Size-based rarefaction and extrapolation analysis and the asymptotic diversity profiles (Step 2) (Figs 3b, 3c, Table 2). The size-based rarefaction and extrapolation analysis depicted in Figures 3B and 3C, along with Table 2, reveal insights into the diversity orders $q = 0$, 1, and 2. The extrapolation for $q = 0$, extending up to double the reference sample size (194), shows variability, suggesting insufficient data for accurate species richness estimation. However, the curves for the diversity of orders $q = 1$ and 2 stabilize, indicating satisfactory asymptotic diversity estimates. The undetected species richness for this dataset is estimated to be at least 3.09 (21.09 – 18) (≥ 5%) (Species richness for $q = 0$) (Fig. 3c, Table 2). The values for Shannon ($q = 1$) and Simpson ($q = 2$) diversity indices are 10.88 and 7.04, respectively. The undetected Shannon and Simpson diversity values within the data are 1.20 and 0.41 (Table 2), implying successful detection of nearly all abundant and highly abundant species.

Non-asymptotic coverage-based rarefaction and extrapolation analysis (Step 3). (Fig. 3d, Table 2).
This step provides the values for species richness, and Shannon and Simpson diversity indices for any fair comparisons among Syrphidae communities.

The value for $C_{\text{max}}$ was defined as 99% (the level of coverage reached by the sample that attains the lowest coverage when all samples are extrapolated to double the reference sample size, 194 individuals) (Table 2, Step 3). At the Maximum standardized coverage $C_{\text{max}} = 99\%$, the values for $q = 0$ (species richness), $q =$
1(Shannon diversity) and q = 2 (Simpson diversity) were 20.47, 10.43 and 6.83, respectively (Table 2, Fig. 3d).

**Table 1.** Hoverflies of Darab Damask Rose Plain, Fars province, ranked in order of abundance, 2019

<table>
<thead>
<tr>
<th>Species</th>
<th>Raw abundance (No.)</th>
<th>Relative abundance (%)</th>
<th>Dominance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sphaerophoria scripta (Linnaeus, 1758)</td>
<td>26</td>
<td>26.8</td>
<td>Do</td>
</tr>
<tr>
<td>2 Euepodes corollae (Fabricius, 1794)</td>
<td>18</td>
<td>18.55</td>
<td>Do</td>
</tr>
<tr>
<td>3 Eumerus ahmadi Barkalov&amp;Gharali, 2004</td>
<td>17</td>
<td>17.5</td>
<td>Do</td>
</tr>
<tr>
<td>4 Ischiodon aegyptius (Wiedemann, 1830)</td>
<td>8</td>
<td>8.25</td>
<td>Sd</td>
</tr>
<tr>
<td>5 Paragus bicolor (Fabricius, 1794)</td>
<td>3</td>
<td>3.1</td>
<td>Re</td>
</tr>
<tr>
<td>6 Paragus quadrifasciatus Meigen, 1822</td>
<td>3</td>
<td>3.1</td>
<td>Re</td>
</tr>
<tr>
<td>7 Eumerus sp1</td>
<td>3</td>
<td>3.1</td>
<td>Re</td>
</tr>
<tr>
<td>8 Scaeva latimaculata (Brunetti, 1923)</td>
<td>3</td>
<td>3.1</td>
<td>Re</td>
</tr>
<tr>
<td>9 Sphaerophoria bengalensis (Macquart, 1842)</td>
<td>3</td>
<td>3.1</td>
<td>Re</td>
</tr>
<tr>
<td>10 Eumerus sp2</td>
<td>2</td>
<td>2.06</td>
<td>Re</td>
</tr>
<tr>
<td>11 Scaeva albomaculata (Macquart, 1842)</td>
<td>2</td>
<td>2.06</td>
<td>Re</td>
</tr>
<tr>
<td>12 Episyrphus balteatus (De Geer, 1776)</td>
<td>2</td>
<td>2.06</td>
<td>Re</td>
</tr>
<tr>
<td>13 Melanostoma mellinum (Linnaeus, 1758)</td>
<td>2</td>
<td>2.06</td>
<td>Re</td>
</tr>
<tr>
<td>14 Paragus auritus Stuckenberg, 1954</td>
<td>1</td>
<td>1.03</td>
<td>Re</td>
</tr>
<tr>
<td>15 Paragus azureus Hull, 1949</td>
<td>1</td>
<td>1.03</td>
<td>Re</td>
</tr>
<tr>
<td>16 Paragus compeditus Wiedemann, 1830</td>
<td>1</td>
<td>1.03</td>
<td>Re</td>
</tr>
<tr>
<td>17 Paragus sp.</td>
<td>1</td>
<td>1.03</td>
<td>Re</td>
</tr>
<tr>
<td>18 Eumerus sp3</td>
<td>1</td>
<td>1.03</td>
<td>Re</td>
</tr>
</tbody>
</table>

| Total species: 18 | 97 |

*Dominance class is indicated by: Do (dominant), Sd (subdominant); and Rc (recedent).

Evenness profile (Step 4) (Fig. 3e, Table 2). In this step, the evenness profile is computed for C\(_{\text{max}}\) = 99%, with Pielou J', q1 and q2 values determined as 0.78, 0.48 and 0.30, respectively.

Non-parametric species richness estimators. The models and non-parametric estimators estimated the species richness of syrphids in the studied area as follows: The Homogenous model yielded an estimated species richness of 20.42 ± 2.18; while the Homogenous (MLE) model estimated a richness of 18.08 ± 0.29; The Chao1 estimator produced a richness estimate of 21.09 ± 3.62; The iChao1 estimator produced a similar estimate to the Chao1, with a richness of 21.09 ± 3.62; The ACE yielded a higher estimate of 22.16 ± 3.89; and the ACE-1 produced an even higher estimate of 22.95 ± 3.14; and the 2\(^{nd}\) order jackknife estimates a richness of 23.99 ± 5.40 (Fig. 4). These results imply that additional sampling in the study area would yield some new species of syrphids, as the estimated species richness is higher than the observed richness in the reference sample data. The high number (15) of rare species with 10 or fewer individuals (cut-off point=10) in the reference sample data (Table 1) is the reason for the increased estimation values. This highlights the importance of considering rare species when estimating species richness in a given area.
Fig. 3. A. The plot of sample completeness curve as a function of order q (ranging from 0 to 2) in the reference sample data (Sobs = 18, n = 97) for Syrphidae of Darab damask rose plain, Iran, 2019; B. Sample-size-based rarefaction and extrapolation curves up to size 194 for Syrphidae sample data, with solid lines and dashed lines representing rarefaction extrapolation, respectively; C. Asymptotic estimates of diversity profiles (solid lines) and empirical diversity profiles (dotted lines) for Syrphidae sample data, with numerical values indicating estimated asymptotic diversities; D. Coverage-based rarefaction (solid lines) and extrapolation (dashed lines) curves up to the corresponding coverage value for size 982; E. Evenness profile as a function of order q, for 0 < q ≤ 2, based on the normalized slope of Hill numbers. observed data points are denoted by solid dots and triangles. All shaded areas in A–D denote 95% confidence bands obtained from a bootstrap method with 100 replications.
Table 2. Numerical values for the three special cases q = 0, 1 and 2 for abundance-based Syrphidae collected from Darab damask rose plain, Fars province, 2019

<table>
<thead>
<tr>
<th>Sample completeness</th>
<th>Step 1. Sample completeness profile</th>
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<tbody>
<tr>
<td></td>
<td>q= 0</td>
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<tr>
<td></td>
<td>85%</td>
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<tr>
<th>Diversity</th>
<th>Step 2. Asymptotic analysis</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>q = 0 (species richness)</td>
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<tr>
<td>Asymptotic estimator</td>
<td>21.09</td>
</tr>
<tr>
<td>Empirical</td>
<td>18</td>
</tr>
<tr>
<td>Undetected</td>
<td>3.09</td>
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<tr>
<th>Diversity</th>
<th>Step 3. Non-asymptotic coverage-based rarefaction and extrapolation</th>
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<tr>
<td></td>
<td>Maximum standardized coverage Cmax = 99%</td>
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<tr>
<td></td>
<td>q = 0 (species richness)</td>
</tr>
<tr>
<td></td>
<td>20.47</td>
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<tr>
<th>Evenness</th>
<th>Step 4. Evenness among species abundance</th>
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<tr>
<td></td>
<td>Pielou J'</td>
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<tr>
<td></td>
<td>q = 1</td>
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<td></td>
<td>q = 2</td>
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<td></td>
<td>0.78</td>
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Discussion

The present study offered the inaugural biodiversity data, described the community structure, examined the sample completeness and inferred the diversity indices of the Syrphidae community in damask rose cultivated land at high altitudes of ca. 2600 m a.s.l. of the Zagros Mountain ranges in the southern part of Iran. Eighteen hoverfly species were collected and identified which make up 6.69% of the Iranian Syrphidae fauna (Dousti, 2023). This richness can increase to a maximum of 24 ± 5.40 species as estimated (Fig. 4) so it indicates that many rare and cryptic species present in the studied area are detectable by more intensive sampling or by implementing other sampling methods (Földesi & Kovács-Hostyánszki, 2014; Moisan-DeSerres et al., 2015; Gervais et al., 2018; Gaytán et al., 2020). Considering whole country with highly diverse natural habitats will give a more complete picture of Iran’s hoverfly richness (Zamani et al., 2018; Babaei et al., 2019; Shojaei Hesari & Pashaei Rad, 2019; Mengual et al., 2021; Gilasian et al., 2022).

In this study, we report a relatively low number of captured specimens (97) which may be attributed to the arid nature, rain-fed environment (Kazerani, 2012; Medeiros et al., 2018), poor floral habitat, and the specific sampling procedure employed (Ahmadian & Pashaei Rad, 2011; Földesi & Kovács-Hostyánszki, 2014; Moisan-DeSerres et al., 2015; Gervais et al., 2018; Gaytán et al., 2020). The life of flower flies is highly associated with water (high rainfall) and flowering plants, this is more likely why the high species diversity of these insects is in regions such as north-western Europe and temperate North America (Robertson et al., 2020).

Fig. 4. Comparison of species richness estimators for Syrphidae community in Darab damask rose plain, Fars province (Iran), 2019. Triangles represent the estimated species richness ± 95% confidence intervals obtained from a bootstrap method with 100 replications.
Our current sampling procedure was based on a single method, Malaise trapping. Likely, the species richness of the family increases if other sampling methods including pan trapping, netting and visual observation extend.

Collected species are common species widely distributed in Iran except for the genus Paragus serratus group of species that are more abundant in the south of Iran. Paragus auritus is here recorded for the first time from Iran. This species is easily distinguished from the other species of the serratus group by a triangular protuberance on the hypandrium. Paragus auritus is a species which occurs in Afrotropical and oriental regions, nicely was detected in this study at the south of Iran (Ante Vujic, personal communication). The dominant and subdominant species of syrphid flies in the studied area were S. scripta, E. corollae, E. ahmadii and I. aegyptius. In common, the most widespread species in Iran are E. balteatus, S. scripta and E. corolla, Eristalis arbuscorum (L., 1758), Eristalis tenax (L., 1758), Syritta pipiens (L., 1758), P. bicolor, M. mellinus and Eristalinus aeneus (Scopoli, 1763) (Ahmadian & Pashaei Rad, 2011; Kazerani, 2012; Naderian et al., 2012; Jabbari et al., 2013; Kamangar & Gharali, 2014; Naderloo & Pashaei Rad, 2014; Babaei et al., 2016; Jalilian, 2019; Rasapour et al., 2021; Dousti, 2023). Some of these species are among dominant and common species in the western Palaearctic (Földesi & Kovács-Hostyánszki, 2014; Gaytán et al., 2020). We recommend the two dominant aphidophagous species, S. scripta and E. corolla, as more suitable in biological control programs in this area.

To conserve this valuable diversity of Syrphidae in the Darab plain of Damask rose, it is strongly recommended that pesticide application is reduced or restricted (Barendregt et al., 2022; Wojciechowicz-Zytko & Wilk, 2023), to ensure natural vegetation and forests as floral, shelter and habitat resources for syrphids within and surrounding of the plain are conserved (Moisan-DeSerres et al., 2015; Gervais et al., 2018; Medeiros et al., 2018; Gaytán et al., 2020; Madureira et al., 2023; Ortega et al., 2023).

In light of these findings, we propose that future research should focus on expanding Syrphidae diversity inventories and monitoring across Iran; taxonomic diversity of the genera Paragus and Eumerus in the southern half of Iran, investigating the ecological requirements of dominant Syrphids for implementing biological control programs, inventing conservation and management strategies.

Author’s Contributions
Abbas Mohammadi-Khoramabadi: conceptualization, methodology, formal analysis, investigation, draft preparation, final review and edit, visualization, supervision, project administration and funding acquisition; Abulfazel Dousti: species identification, final review and edit; Babak Gharaei: species identification, final review and edit.

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Data Availability Statement
All data supporting the findings of this study are available within the paper.

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Ethics approval
Insects were used in this study. All applicable international, national, and institutional guidelines for the care and use of animals were followed. This article does not contain any studies with human participants performed by any of the authors.
Conflict of interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

REFERENCES
Diversity of Hoverflies in Darab damask rose rain-fed plain ...


تنهیه کلاس‌های مگس‌های کل (Diptera, Syrphidae) در دشت گل موم‌های دیم داراب، استان فارس، ایران

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م modifiers: 

مقدمه

تویپ کلاس‌های مگس‌های کل (Diptera, Syrphidae) در دشت گل موم‌های دیم داراب، استان فارس، ایران از دو گونه بومی دارد. این گونه‌ها شامل: Eusyrphus auritus (Linnaeus, 1758) و Stuckenberg, 1954 Paragus auritus هستند. در این مقاله، شناخت گونه‌های بومی دشت گل موم‌های دیم داراب و آمار گونه‌ها در این محیط محاسبه شد.

۱۹-۲۴ متر در دشت گل موم‌های دیم داراب، استان فارس، ایران، جهت مطالعه و شناسایی گونه‌های بومی، طرح‌های زیست‌شناسی و محاسبه آمار گونه‌ها انجام شد. این آمار، عامل کلیدی در تحقیق و شناسایی گونه‌ها می‌باشد.

کلمات کلیدی: سایت، هوا، کشاورزی، مرمت‌کننده

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