DE GRUYTER
OPEN

Hellenic Plant Protection Journal **12:** 12-21, 2019
DOI 10.2478/hppj-2019-0003

Biodiversity and population fluctuations of parasitoids of the white peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Hemiptera: Diaspididae), in kiwifruit orchards in Northern Iran

A.H. Toorani[1*], H. Abbasipour[2] and L. Dehghan-Dehnavi[3]

Summary The white peach scale, *Pseudaulacaspis pentagona* Targioni-Tozzetti (Hemiptera: Diaspididae), is one of the most important and destructive polyphagous pests of the Rosaceae family trees. Population fluctuations and biodiversity of the hymenopteran parasitoid species associated with the pest were studied in six kiwi orchards in Iran, during one-year period. Parasitoid species abundance, species diversity indices and evenness indices were calculated. Most of the parasitoid species were dominant or eudominant. Based on the alpha diversity indices, the Najarkola region had high diversity and the Kharatkola region had low diversity. The Paeendasteh region (based on Simpson's Diversity on Camargo evenness indices) and the Samnakola region (based on the modified Nee, and on Smith and Wilson evenness indices) were less uniform. Among the recorded parasitoids, *Encarsia berlesei* Howard (Hymenoptera: Aphelinidae), followed by *Aphytis proclia* Walker (Hymenoptera: Aphelinidae), had the highest population in all orchards.

Additional keywords: Pseudaulacaspis pentagona, parasitoids, diversity, evenness index, species abundance, species richness

Introduction

The white peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Hemiptera: Diaspididae), is the most important pest of kiwi fruit trees in Iran and other countries (Miller and Davidson, 2005; Toorani, 2017), attacking branches and twigs. The scale is most often seen in large numbers on the bottom of stems. The scale feeds on plant sap, and infestation causes leaves to yellow or defoliation and branches to dry. Fruit size may be reduced and premature drop is likely. Heavy infestations can result in stunting and the death of branches and dieback (Ezzat and Nada, 1986).

The families Aphelinidae and Encyrtidae are the most successful groups of Chalcidoidea, Hymenoptera used in the biological control of pest scale insects (Guerrieri and Noyes, 2000). Regarding reports on parasitoids of the white peach scale, the solitary endoparasitoid *Encarsia berlesei* Howard (Hym.: Aphelinidae) is considered to be the most effective species among the white peach scale natural enemies (Collins and Whitecomb, 1975), whose origin, like the white peach scale, is East Asia. *Aphytis chrysomphali* (Mercet) (Hym.: Aphelinidae) has been reported on the white peach scale in apricot and cherry trees from Shanghai, China (Invasive Species Compendium, 2016). In Iran, another three parasitoid species have been recorded, *Aphytis proclia* Walker (Hym.: Aphelinidae) (Modarres Awal, 1997), *Ablerus perspeciosus* Girault (Hym.: Aphelinidae) (Jamalomidi *et al*., 2012) and *Teleterebratus perversus* Compere and Zinna (Hym.: Encyrtidae) (Toorani, 2017).

Protecting biodiversity of taxonomic groups for which there are no available data on their existence or role in the ecosystem, is an important subject (Gaston, 1991). Alpha (α) diversity is intra (within) - habitat diversity. The species diversity is the main level

[1,2]MSc gratuated student and professor, Department of Plant Protection, Faculty of Agricultural Sciences, Shahed University, Tehran, Iran.
[3] Young Researchers and Elite Club, Yard Branch, Islamic Azad University, Yarzd, Iran.
* Corresponding author: Amirhoseyn.toorani@gmail.com

of alpha diversity in the sense of the number of existing species and their abundance (evenness) in a geographical region, which increases with increasing number of existing species.

The present study was carried out to provide information on the species composition, diversity, evenness and population fluctuations of the hymenopterous parasitoids associated with the white peach scale, *P. pentagona,* in kiwi orchards in Iran.

Materials and methods

Experimental set up and data collection

This study was carried out in the kiwi orchards of Qaemshahr city, Mazandaran province of Iran. The laboratory experiments were carried out in the laboratory of Entomology and Insectarium of the Faculty of Agriculture Sciences of Shahed University of Tehran. In order to study the population fluctuations of parasitoid species associated with the pest under natural conditions on kiwi trees, six orchards, which had a history of pest infestation in previous years and had not received pesticides, at Qaemshahr and Mollakola areas (36° 35′ 44.20′′ N, 52° 46′ 35.09′′ E and -10.23 m a.s.l); Borjekheyl (36° 36′ 3.43 N, 52° 46′ 23.94 E and -13.28 m a.s.l); Kharatkola (36° 33′ 1.07′′ N, 52° 50′ 12.08′′ E and -4.23 m a.s.l); Paeendasteh (36° 36′ 39.59′′ N, 52° 47′ 47.39′′ E and -11.63 m a.s.l); Samnakola (36° 32′ 51.40′′ N, 52° 48′ 34.03′′ E and -0.21 m a.s.l and Najarkola (36° 33′ 20.26 N, 52° 48′ 55.42 E and -3.99 m a.s.l) were selected for sampling.

Sampling started on April 30, 2015, and ended on April 29, 2016. The samples were collected biweekly until January 22, 2016, and then monthly. Ten trees were randomly selected and marked on each date. Four infested branches were cut to a length of 10 cm each and placed in plastic glasses (5 cm diameter and 10 cm height), closed with a net cloth. Emerged parasitoids were collected and stored in 75% ethanol. In addition, on some sampling dates, a large number of infested branches of kiwi trees, were placed in cardboard boxes (50×20×45 cm) bearing six test tubes on each side of the box. The boxes were kept under natural conditions and emerging parasitoids were collected in the test tubes at 10-day intervals and stored in alcohol. The collected specimens were primarily identified and then, were sent for confirmation of identification, to Dr Andrew Polaszek, Department of Life Sciences, Natural History Museum.

Estimation of parasitoid species composition, abundance, diversity, evenness and population fluctuations

The data from the aforementioned six areas were used to calculate species diversity during 2015-2016. After identifying and counting the captured specimens, the dominant structure of species composition was evaluated using the method of Headman (Weigmann, 1973). In this method, the species, which their abundances are more than 30% of the society are identified as eudominant species, 10-30% as dominant, 5-10% as subdominant, 1-5% as rare, and less than 1% as sub-rare species.

Species diversity and relative abundance of the parasitoid species of *P. pentagona* were calculated in the different ecosystems of the Mazandaran province, using the Ecological Methodology software version 7.2. Based on the number of individuals per parasitoid species in each region, indicators of species diversity (number of species in a community, diversity in a region) and species evenness (number of individuals for each species, abundance and proportion of individuals of each species) were calculated.

Alpha species diversity was estimated using the Indices Shannon-Wiener (Shannon and Weaver, 1949) as the most common indicator to measure biodiversity and sensitive to the abundance of rare species in the community, Simpson's (Simpson, 1949) as a sensitive index to changes in more abundant species, and Brillouin (Pielou, 1969) as most appropriate for cases in which data are related to limited collections.

To estimate species equitability or even-

ness, the Smith and Wilson (Smith and Wilson 1996), modified Nee (Nee *et al.* 1992), Simpson (Simpson 1949) and Camargo (Camargo 1992) indices were used.

Results

Parasitoid species composition

In total, six parasitoid species were recorded in the study areas i.e. *Encarsia perniciosi* Tower (Hymenoptera: Aphelinidae), *A. chrysomphali, E. berlesei, A. perspeciosus, A. proclia, T. perversus*. Results for the species composition in each region are shown in Table 1.

Parasitoid species abundance

Encarcia perniciosi and *A. chrysomphali* had the highest abundance percent at Samnakola and Najarkola orchards, while *E. berlesei* and *A. proclia* had the highest abundance percent at Mollakola orchard. The abundance of *E. berlesei* species at Kharatkola orchard was (83.66%). The abundance of *A. perspeciosus* was zero at Mollakola, Borjekheyl and Kharatkola orchards (Table 1). According to Headman's categorization on species dominance proportion in the society (Weigmann, 1973), most of the six collected were eudominant or dominant (Table 1).

Alpha diversity

According to all indices, the parasitoid species diversity was higher in all regions compared to the Kharatkola region (Figure 1).

Species evenness

Based on the results obtained from the Camargo and Simpson eveness indices (Figure 2), the Paeendasteh region was the least uniform whereas according to the modified Nee index and the Smith and Wilson index, the Samnakola region were the least uniform (Figure 2). Based on diversity studies, the more uniform the species diversity is, the more diversity exists in the environment.

Population fluctuation of parasitoids

Figure 3 shows that the population of the parasitoids of the white peach scale dif-

Table 1. Relative abundance (%) and dominance proportion of parasitoids of the white peach scale, *Pseudaulacaspis pentagona,* in kiwi orchards in six regions of northern Iran during 2015-2016.

Species	Samnakola	Najarkola	Mollakola	Borjekheyl	Kharatkola	Paeendasteh
Encarsia perniciosi	30.9 Eudominant (233)	27.09 Dominant (207)	6.68 Subdominant (49)	6.08 Subdominant (54)	0 Subrare (0)	2.55 Rare (9)
Aphytis chrysomphali	25.9 Dominant (196)	52.9 Dominant (176)	7.77 Subdominant (57)	22.07 Dominant (196)	0 Subrare (0)	36.07 Eudominant (127)
Encarsia berlesei	19.8 Dominant (149)	19.63 Dominant (150)	45.42 Eudominant (333)	31.64 Eudominant (281)	83.66 Eudominant (128)	47.72 Eudominant (168)
Ablerus perspeciosus	17.1 Dominant (129)	19.37 Dominant (148)	0 Subrare (0)	0 Subrare (0)	0 Subrare (0)	9.94 Subdominant (35)
Aphytis proclia	5.7 Subdominant (43)	8.24 Subdominant (63)	40.10 Eudominant (294)	40.2 Eudominant (357)	12.41 Dominant (19)	1.70 Rare (6)
Teleterebratus perversus	0.53 Subrare (4)	2.61 Rare (20)	0 Subrare (0)	0 Subrare (0)	3.92 Rare (6)	1.98 Rare (7)

Parasitoid species categorization by Headman (Weigmann, 1973) according to their dominance proportion in the society: eudominant (>30%), dominant (10-30%), subdominant (5-10%), rare (1-5%), sub-rare (< 1%).
Number in parentheses indicate the sample size.

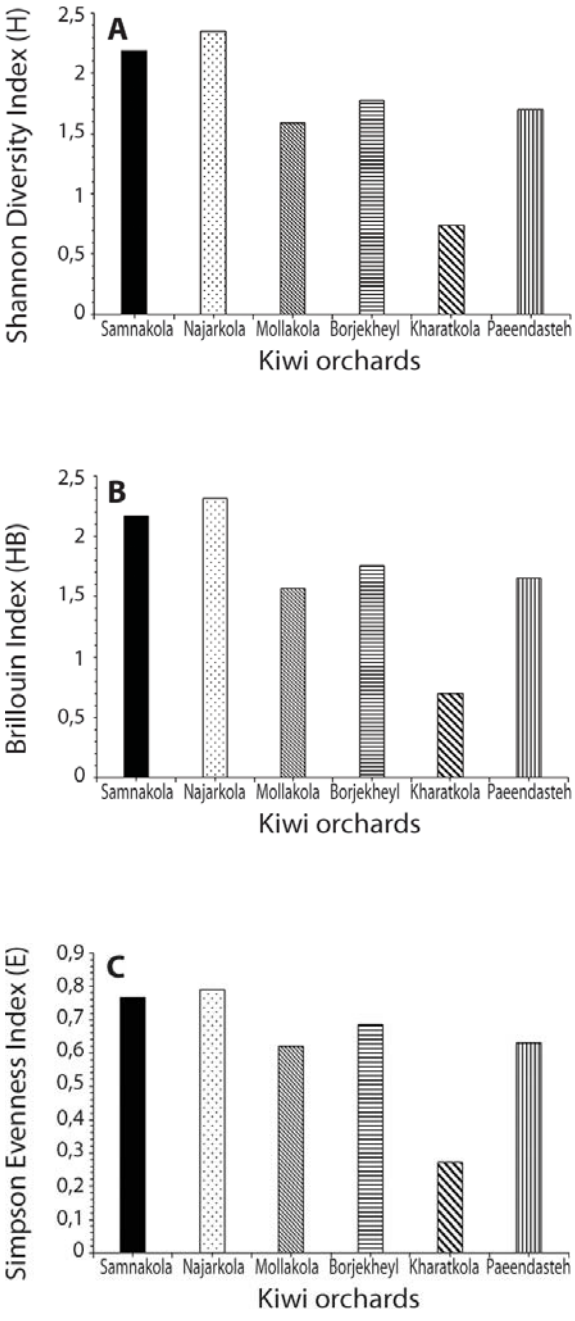


Figure 1. Alfa species diversity indices of parasitoids of the white peach scale, *Pseudaulacaspis pentagona*, in kiwi orchards in six regions of northern Iran during 2015-2016: A) Shannon Wiener diversity index, B) Brillouin diversity index, C) Simpson diversity index.

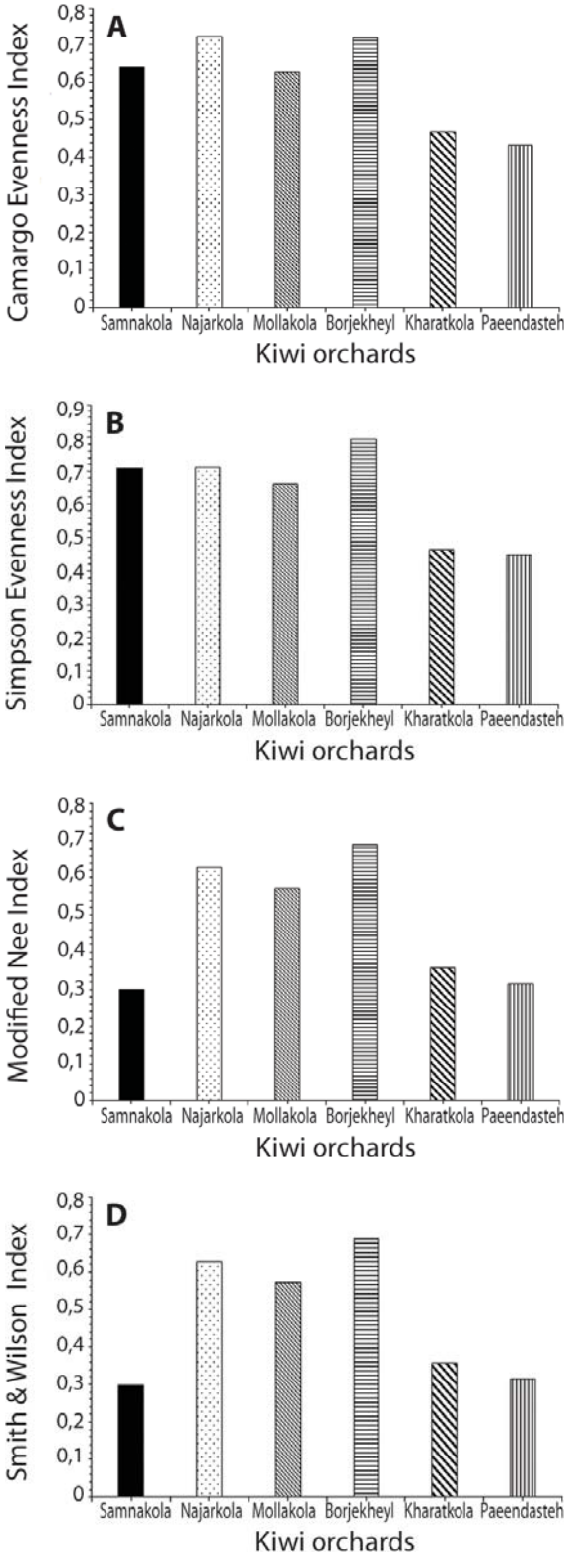
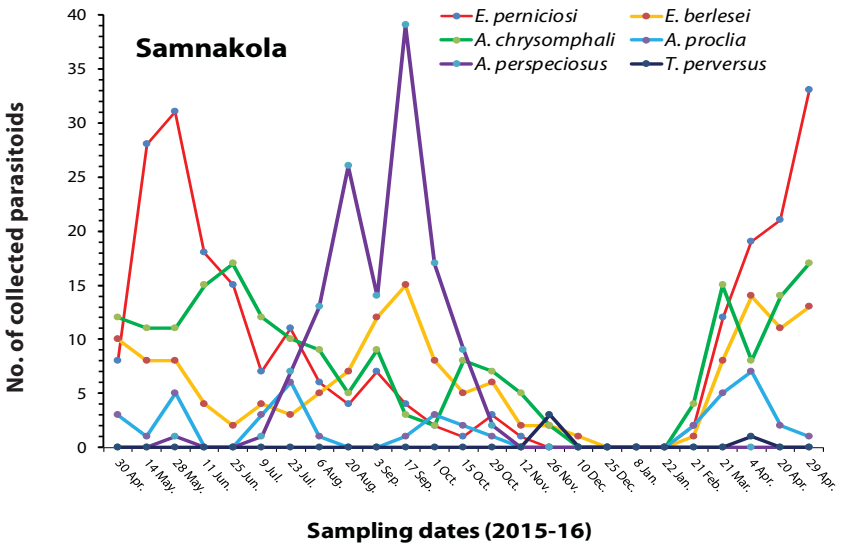
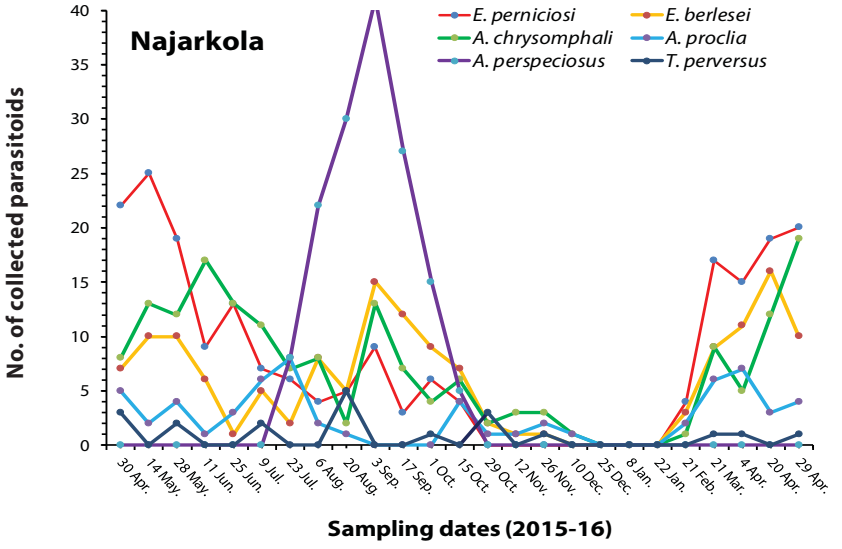
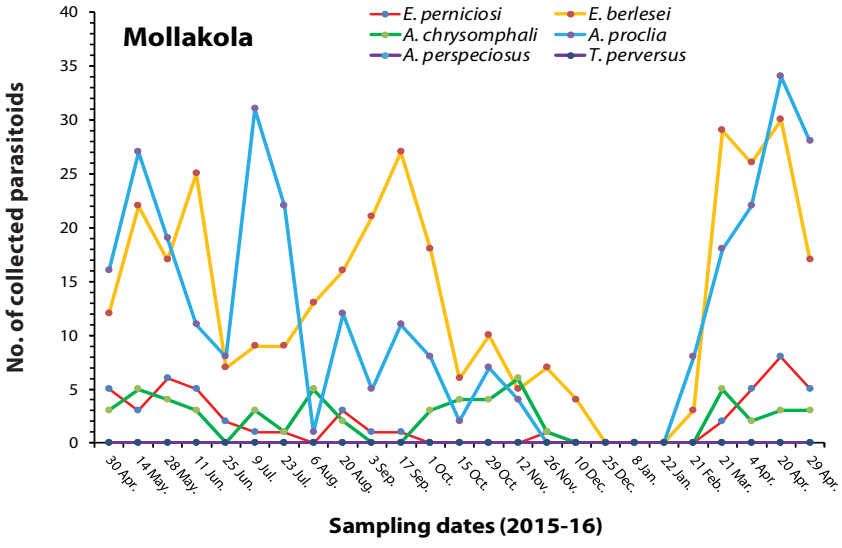


Figure 2. Species evenness indices of parasitoids of the white peach scale, *Pseudaulacaspis pentagona*, in kiwi orchards in six regions of northern Iran during 2015-2016: A) Camargo evenness index, B) Simpson evenness index, C) Modified Nee evenness index, D) Smith and Wilson evenness index.







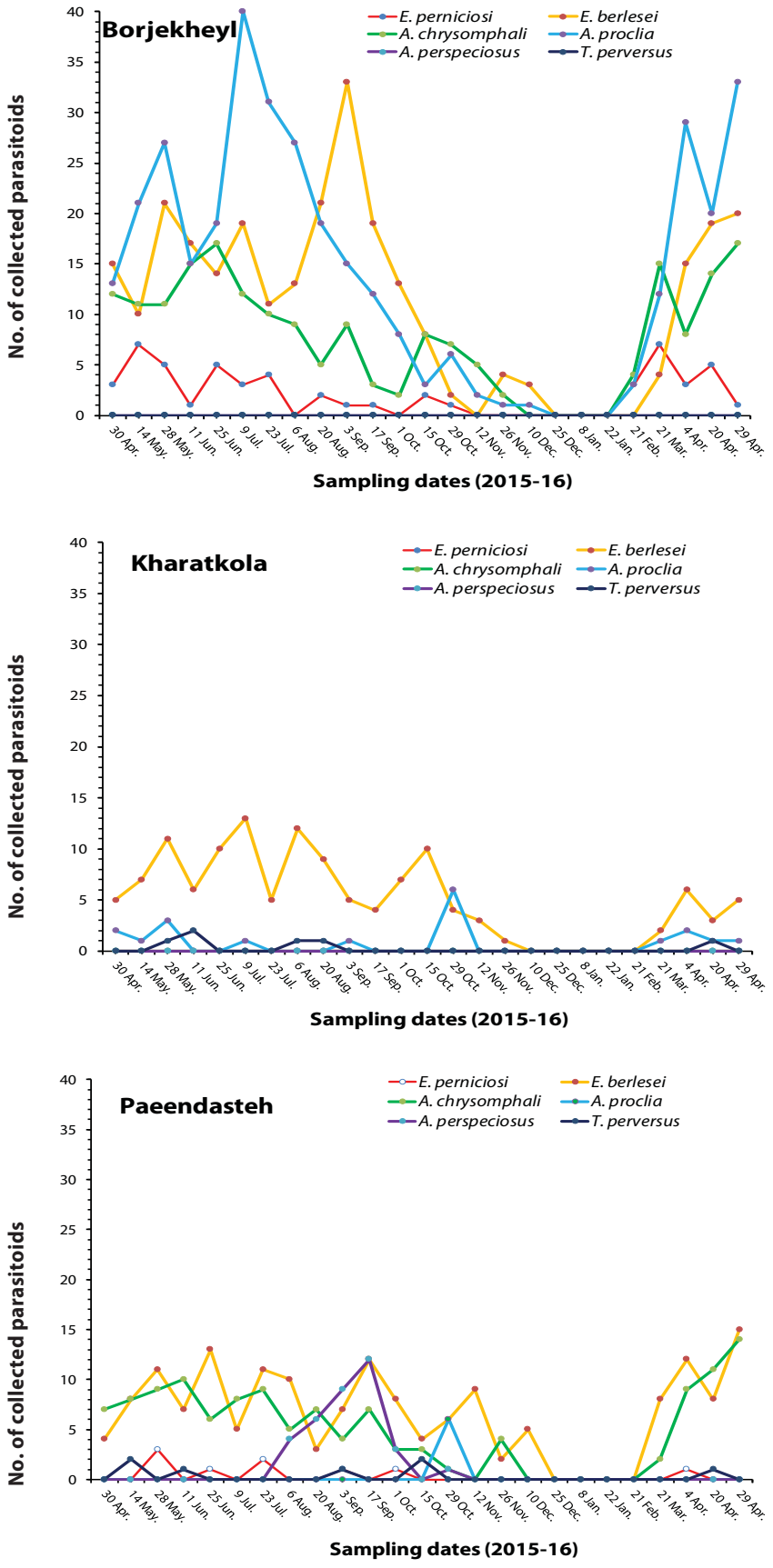


Figure 3. Population fluctuations of different species of parasitoids of the white peach scale, *Pseudaulacaspis pentagona*, in kiwi orchards of northern Iran during 2015-2016.

fers among the studied orchards as well as on different sampling dates, reaching the lowest (zero) at the end of December - beginning of January in all orchards due to coincidence with the winter colds and overwintering of these parasitoids.

In all orchards, *E. berlesei* (n= 1209) had the highest numbers followed by *A. proclia* (n= 782). These two species had significant ups and downs during sampling. *Ablerus perspeciosus* was observed in three orchards in the areas of Samankola, Najarkola and Paeendasteh, showing 1-2 peaks from August to October. *Encarsia perniciosi* and *A. chrysomphali* were collected from all the studied orchards, except for the one in Kharatkola, and were present from spring to autumn with their population reducing until reaching zero in the winter. *Teleterebratus perversus* was recorded in small numbers from spring to autumn at the orchards of the areas Najarkola, Kharatkola and Paeendasteh.

Discussion

To our knowledge this is the first record on the biodiversity and population fluctuation of the parasitoid species of the white peach scale in kiwi orchards in Iran. Five out of the total six species recorded in the samples are known to parasitize *P. pentagona* in Iran, i.e. *Encarsia berlesei* Howard (Hymenoptera: Aphelinidae) (the most effective), *Aphytis chrysomphali* (Hymenoptera: Aphelinidae) (Invasive Species Compendium, 2016) *Aphytis proclia* Walker (Hymenoptera: Aphelinidae) (Modarres Awal, 1997), *Ablerus perspeciosus* (Jamalomidi *et al*., 2012) and *Teleterebratus perversus* (Toorani, 2017). *Encarsia perniciosi* has not been reported on the white peach scale in Iran.

Encarsia berlesei was the most abundant of all parasitoid species in all regions of the study. Except of the wheat peach scale, it parasitizes another 10 species of the Diaspididae family, including *Aulacaspis cinnamomi* Newstead, *Chrysomphalus dictyospermi* Morgan, *Chrysomphalus obscurus* Lizer y Trelles, *Diaspis pentagona* Fargioni, *Melanaspis obscura* Comstock, *Nuculaspis abietis* Schrank, *Parlatoria pergandii* Comstock, *Pinnaspis minor* Maskell, *Pinnaspis strachani* Cooley and *Pinnaspis temporaria* Ferris (Natural History Museum, 2016). Other hosts of *A. chrysomphali* include various scale species in the families of Coccidae and Diaspididae (61 species) (Natural History Museum, 2016).

Records of other host scales of *E. perniciosi*, *A. proclia* and *A. perspeciosus* in Iran include: *E. perniciosi* has been reported on *Quadraspidiotus perniciosus* Comstock (Modarres Awal, 1997; Ghahari *et al*., 2011), *Aonidiella aurantii* Maskell, *Lepidosaphes ulmi* Linnaeus, *Parlatoria acalcarata* McKenzie and *Quadraspidiotus gigas* Ferris (Heraty *et al*., 2007); *A. proclia* has been recorded on *A. aurantii*, *Aonidiella orientalis* Newstead, *C. dictyospermi*, and *Parlatoria oleae* Colvee (Modarres *et al*., 1997); *A. perspeciosus* has been found on *Q. perniciosus* Comstock (Abd-Rabou and Ghahari 2005; Aliakbar Aghadokht *et al*., 2010) and *Aleurolobus barodensis* Maskell (Hemiptera: Aleyrodidae) (Jamalomidi *et al*., 2012).

Differences in the parasitoid species composition, richness and abundance among the studied areas could be attributed to several factors that can affect the presence of a parasitoid in the orchard, such as the type of vegetation around the orchard, the history of chemical applications in the orchard, the area and age of the trees, the population of the host pest, as well as environmental parameters (temperature, humidity, latitude and longitude, sea level altitude) (Lotfalizadeh *et al*., 2014; Habibi Badrabadi *et al*., 2017 and Iranmanesh *et al*., 2017). The richer species composition and abundance of parasitoid species of the white peach scale in Samnakola, compared to the other areas, could be related to the fact that the majority of orchards in this area are kiwi trees, dating for several years. The poorer species variety and number of parasitoids in Kharatkola could be associated to the presence of only one kiwi orchard and the young age of the trees, whereas rice is the dominant cultiva-

tion in the region.

Lower richness in the Kharatkola, Borjekheyl and Paeendasteh regions can be associated with the application of organophosphorus pesticides (such as chlorpyrifos and diazinon), whereas applications with mineral oil and botanical pesticides are related to higher richness in Samnakola, Najarkola and Mollakola (unpublished data). Nevertheless, Kyparissoudas (1987) showed that in orchards where chemical pesticides were applied, *E. perniciosi* wasps were not captured in pheromone traps of its host *Q. perniciosus*.

The population of parasitoid species of *P. pentagona* varied in the sampling regions. *Encarsia berlesei* had 4-6 population peaks on white peach scale in kiwi orchards in the present study. Bazrafshan *et al*. (2010) observed two peaks of the parasitism rate for the parasitoid on peach trees. Moreover, they showed that plant species has an effect on the rate of parasitism and the associated number of peaks. In our case, it is possible that the activity of parasitoids is favored by the micro-climate conditions in kiwifruit orchards (in comparison to peach orchards), where the pest is located on shoots in the shade.

According to Pedata *et al*. (1995), the population of *A. proclia* on white peach scale in a mulberry orchard in Campania, Italy, reached a peak in April, which is similar to the results of the present study. Seasonal abundance of *Aphytis* sp. had three larval and pupal peaks on white peach scale in peach trees in Dakahlia governorate, Egypt, in two successive seasons (2013-2014 and 2014-2015) (Halawa *et al*., 2015).

In the Hafez (1988) study, *A. chrysomphali* was found to be fairly abundant on *A. aurantii* in *Citrus sinensis* orchards in Alexandria, Egypt, with three peaks of activity in June, October and November.

Conclusions

In conclusion, results of the present study corroborate the existence of several hymenopterous parasitoid species of *P. pentagona* in kiwi fruit orchards in Iran. In general, *E. berlesei*, *A. chrysomphali* and *A. proclia* were abundant in most of the study regions. In view of the high prevalence of these species at the peak population dates, these results, together with the data on the parasitoid population changes over the crop season, can facilitate the designing of biological control programs against the white peach scale.

We are thankful of Faculty of Agricultural Sciences, Shahed University, Tehran, Iran for having supported our research.

Literature Cited

Abd-Rabou, S. and Ghahari, H. 2005. List of hyperparasitoids of whiteflies and coccids (Homoptera) In Iran, with special study on Iranian *Ablerus* (Hymenoptra: Aphelinidae). *Egyptian Journal of Agricultural Research*, 83 (1): 311-317.

Aliakbar Aghadokht, P., Sarailoo, M.H., Yazdanian, M., Mottaki, E. and Polaszek A. 2010. New report for wasp's fauna for Iran. *Proceedings of 19th Iranian Plant Protection Congress, Iranian Research Institute of Plant Protection, Tehran*, 122.

Bazrafshan, B., Razmjou, J., Damavandian, M.R. and Rafiee Dastjerdi, H. 2010. Population dynamics of the white peach scale, *Pseudaulacaspis pentagona* and its important natural enemies in Mazandaran. M.Sc. thesis, Mohaghegh Ardabili University, Ardabil, Iran.

Camargo J.A. 1992. New diversity index for assessing structural alterations in aquatic communities. *Bulletin of Environmental Contamination and Toxicology*, 48 (3): p.428-434.

Collins, F.A. and Whitcomb, W.H. 1975. Natural enemies of the white peach scale, *Pseudaulacaspis pentagona* (Homoptera: Cooccidae), in Florida. *Florida Entomologist*, 54 (1): 91-95.

Ezzat, Y.M. and Nada, S.M. 1986. List of superfamily Coccoidea as known to exist in Egypt. *Bollettino del Laboratorio di Entomologia Agraria, Filippo Silvestri*, 43: 85-90.

Gaston, H.J. 1991. The magnitude of global insect species richness. *Conservation Biology*, 5: 283-296.

Ghahari, H., Huang, J. and Abd-rabou, S.A. 2011. Contribution to the *Encarsia* and *Eretmocerus* (Hymenoptera: Aphelinidae) species from the Arasbaran biosphere reserve and vicinity, northwestern Iran. *Archives of Biological Science Belgrade*, 63 (3): 867-878.

Guerrieri, E. and Noyes, J.S. 2000. Revision of European species of genus *Metaphycus* Mercet (Hymenoptera: Chalcidoidea: Encyrtidae), parasitoids of scale insects. *Systematic Entomology*, 25: 147-222.

Habibi Badrabadi, S., Khayrandish, M. and Mohammadi-Khoramabadi, A. 2017. Faunistic survey and species diversity of parasitoid wasps of Pimpiliformes and Ichneumoniformes Groups (Hymenoptera: Ichneumonidae) in Yazd Province, Iran. *Taxonomy and Biosystematics*, 32: 4-20.

Hafez, M.B. 1988. Population fluctuations on parasites of California red scale, *Aonidiella aurantii* (Mask.) (Hem.: Diaspidae) in Alexandria. *Journal of Applied Entomology*, 106: 183-187.

Halawa, A.M., Nour EL-Deen, M.A., Attia, S.A. and EL-Sebaay, M.M. 2015. Population fluctuation of the white peach scale insect, *Pseudaulacaspis pentagona* (Targioni), associated parasitoid and predacious mites attacking peach trees at Dakahlia Governorate. *Middle East Journal of Agriculture*, 4(2): 250-259

Heraty, J. M., Woolley, J. B. and Polaszek, A. 2007. Catalog of the *Encarsia* of the world. http://cache.ucr.edu/~heraty/ Encarsia.cat.pdf.

Invasive Species Compendium. 2016. From http://www.cabi.org/isc/datasheet/45077.

Iranmanesh, M., Madjdzadeh, S.M. and Askari Hesni, M. 2017. Biodiversity of braconid fauna (Hym.: Ichneumonoidea: Braconidae) in Sirch region, Kerman province, Iran. *Journal of Entomological Society of Iran*, 37 (1): 1-13.

Jamalomidi, A., Hosseini, R., Sahragard, A. and Hajizadeh, J.A. 2012. Faunal study on armored scales (Hem: Diaspididae) parasitoids on citrus trees in eastern part of Guilan province. *Proceedings of 20th Iranian Plant Protection Congress, University of Shiraz*, 217.

Kyparissoudas, D.S. 1987. The occurrence of *Encarsia perniciosi* in areas of northern Greece as assessed by sex pheromone traps of its host *Quadraspidiotus perniciosus*. *Entomologia Hellenica*, 5: 7-12.

Lotfalizadeh, H., Zargaran, M.R. and Taghizadeh, M. 2014. Speceis diversity of Coccoidea parasitoids wasps (Hym.: Chalcidoidea) in the northern parts of East-Azarbaijan province, Iran. *North-Western Journal of Zoology*, 10(1): 60-66.

Magurran, A.E. 2004. Measuring biological diversity, Blackwell Publishing: Oxford, UK. 256 p.

Miller, D.R. and Davidson, J.A. 2005. *Armored scale insect pests of trees and shrubs*. Cornell University Press. pp. 437.

Modarres Awal, M. 1997. Family Aphelinidae (Hymenoptera), pp. 261-262. In: Modarres Awal, M. (ed.) *List of agricultural pests and their natural enemies in Iran*. Ferdowsi University Press, 429.

Natural History Museum. 2016. From http://www.nhm.ac.uk/our-science/data/chalcidoids/database/ detail.

Nee, S., Harvey P.H. and Cotgreave, P. 1992. Population persistence and the natural relationship between body size and abundance. In: *Conservation of Biodiversity for Sustainable Development* (Sandlund O.T., Hindar K. and Brown A.H.D. eds), p. 124-136. Scandinavian University Press, Oslo.

Pedata, P.A., Hunter, M.S. and Godfray, H.C.J. 1995. The population dynamics of the white peach scale and its parasitoids in a mulberry orchard in Campania, Italy. *Bulletin of Entomological Research*, 85: 531-539.

Peet, R.K. 1974. The measurements of species diversity. *Annual Review of Ecology and Systematics*, 5: 285–307.

Pielou, E.C. 1969. An introduction to mathematical ecology. New York: Wiley.cited in VIII + 286 S., 32 Abb., Preis 140s.

Simpson, E.H. 1949. *Measurement of diversity*. Nature 163, 688.cited in Magurran, A. E., 2004, *Measuring biological diversity*, Blackwell Publishing: Oxford, UK.256 p.

Shannon, C.E. and Weaver, W. 1949. *The Mathematical Theory of Communication*. University of Illinois Press, Urbana.Weigmann, G. 1973. Zur Ökologie der Collembolen und Oribatiden im Grenzbereich Land-Meer (Collembola, Insecta – Oribatei, Acari). Zeitschrift für wissenschaftliche Zoologie, 186: 295–391.

Smith, B. and Wilson, B. 1996. A consumer's guide to evenness indices. *Gikos,* 76 (1): 70-82.

Toorani, A.H. 2017. Study of population fluctuations of the white peach scale, *Pseudaulacaspis pentagona* Targioni-Tozzetti and its natural enemies in kiwi gardens of Ghaemshahr region. M.Sc. thesis in Agricultural Entomology, Faculty of Agriculture, Shahed University, Tehran, Iran, 117 p.

Weigmann, G. 1973. Zur Ökologie der Collembolen und Oribatiden im Grenzbereich Land-Meer (Collembola, Insecta - Oribatei, Acari). *Zeitschrift für wissenschaftliche Zoologie*, 186: 295-391.

Received: 28 July 2018; Accepted: 13 December 2018

Βιοποικιλότητα και πληθυσμιακές διακυμάνσεις παρασιτοειδών του κοκκοειδούς *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Hemiptera: Diaspididae) σε οπωρώνες ακτινιδίου στο Βόρειο Ιράν

A.H. Toorani, H. Abbasipour και L. Dehghan-Dehnavi

Περίληψη Το κοκκοειδές *Pseudaulacaspis pentagona* Targioni-Tozzetti (Hemiptera: Diaspididae) είναι ένας από τους πιο σημαντικούς και καταστρεπτικούς πολυφάγους εχθρούς των δέντρων της Οικογένειας Rosaceae. Οι διακυμάνσεις του πληθυσμού και η βιοποικιλότητα των υμενόπτερων παρασιτοειδών του κοκκοειδούς μελετήθηκαν σε έξι οπωρώνες ακτινιδίου στο Ιράν κατά τη διάρκεια ενός έτους. Εκτιμήθηκαν η σχετική αφθονία τους, δείκτες ποικιλότητας και δείκτες ισομέρειας. Τα περισσότερα από τα είδη των παρασιτοειδών ήταν κυρίαρχα (dominant) ή eudominant. Με βάση τους δείκτες ποικιλότητας, η περιοχή Najarkola είχε μεγάλη ποικιλομορφία και η περιοχή Kharatkola είχε μικρή ποικιλομορφία. Η περιοχή Paeendasteh (με βάση τους δείκτες ποικιλότητας Simpson και ισομέρειας Camargo) και η περιοχή Samnakola (με βάση τους δείκτες ισομέρειας, τροποποιημένος δείκτης Nee, και δείκτης Smith και Wilson) ήταν λιγότερο ομοιόμορφες. Μεταξύ των ειδών παρασιτοειδών, το *Encarsia berlesei* Howard (Hymenoptera: Aphelinidae) και το *Aphytis proclia* Walker (Hymenoptera: Aphelinidae) είχαν τον υψηλότερο πληθυσμό σε όλους τους οπωρώνες.

Hellenic Plant Protection Journal **12:** 12-21, 2019