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A review of *Rhinolophus mehelyi* in Iran with new distributional records

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We review earlier distributional records of Mehely's horseshoe bat, *Rhinolophus mehelyi,* in Iran and report new distribution records obtain during 2014–2017. Until 2012, *R. mehelyi* had been recorded from 14 localities. We report ten new locality records and therefore increasing the known range to Zagros Mts. We also report echolocation-call parameters for 42 individuals caught in six caves which represent the first information from Iran.

Key words: *Chiroptera, Iran, new records, Rhinolophus mehelyi, Zagros Mountains.*

INTRODUCTION

De Filippi provided the first inclusive list of the mammals including bats in Iran (De Filippi, 1865). Several European and American scientists including Blanford (1876), Thomas (1905), Cheesman (1921), Misonne (1959), Lay (1967), DeBlase (1980, 1972), and Benda *et al.* (2012) have studied the bat fauna of Iran. Among Iranian chiropterologists Etemad (1969), Farhang-Azad (1970, 1971), Sharifi *et al.* (2000, 2004), Karami *et al.* (2008), Akmali *et al.* (2011, 2015) and Shahabi *et al.* (2017a, b) had contribution to diversity, taxonomy and biogeography of the chiropteran species. DeBlase (1980) has an important contribution on the Iranian bat studies by reporting 38 species from Iran. Karami *et al.* (2008) reported 45 species of bats in Iran but Benda *et al.* (2012) increased the number of species to 49. The most recent new record was by Naderi *et al.* (2017) who reported Nathusius' Pipistrelle, *Pipistrellus nathusii* from northern Iran. This report increases the number of bats in Iran to 50. Two valid subspecies of *R. mehelyi* have been recorded for this species. The nominate form *R. mehelyi mehelyi* ranges within Europe and western Asia and *R. mehelyi tuneti* ranges within the northern Africa (Csorba *et al.*, 2003).

The Family Rhinolophidae, generally known as horseshoe bats, comprises a single genus, *Rhinolophus*, and 77 currently recognized species (Simmons, 2005b). The Rhinolophidae form a fully supported monophyletic group but intrafamilial relationships are less well resolved. The species radiation of Rhinolophid bats started 15-17 million years ago (Guillén *et al.*, 2003) and widely distributed throughout the Old World at both temperate and tropical regions. These species are found in Africa, Asia, northern and eastern Australia, southern Europe, and several Pacific islands (Hill & Smith, 1984; Vaughan *et al.*, 2000). They forage both in forests and within open spaces. Rhinolophid bats use caves, tree holes, foliage, mines, and buildings for roost (Vaughan *et al.*, 2000). Species that hibernate may use different roost types in the summer and winter months (Vaughan *et al.*, 2000). Horseshoe Bats have a very old origin compared to other mammal groups of similar

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taxonomic status, probably having diverged from the Hipposiderid by the late Eocene (Csorba *et al*., 2003)

The Mehely's horseshoe bat, *Rhinolophus mehelyi,* (Matschie, 1901), type locality in Romania, Bucharest, is a species of bat in the family Rhinolophidae (Corbet, 1978). This species has a discontinuous distribution from North Africa (Morocco, Algeria, Tunisia, Libya and Egypt) and southern Europe (southern Portugal and Spain, possibly one record for France, the Balkans and Cyprus) through Asia Minor, Anatolia, to Transcaucasia, Iran and Afghanistan (Gaisler, 2001c; Csorba *et al*., 2003). *R. mehelyi* is distributed mainly in the Mediterranean habitats of Middle East including Anatolia, Cyprus, Levant, Palestine, Iran and in the Mediterranean parts of North Africa, it occurs also in Mesopotamia from Turkey to Iraq (DeBlase, 1972; Gaisler, 2001c). At the eastern margin of the Near East, *R. mehelyi* reaches the eastern limit of its distribution range. However, this species was overlooked in this area for a long time (DeBlase, 1972). Besides the Middle East, *R. mehelyi* is distributed in Palaearctic Asia only in Transcaucasia (Benda *et al*., 2006). *R. mehelyi* is a medium-sized horseshoe bat that forages in Mediterranean shrubland and woodland, and in dry steppes. It emerges at dusk, hunts low over ground, also amongst bushes and trees, flying slowly and feeding mainly on moths (Sharifi & Hemmati, 2004; Salsamendi *et al*., 2008). Summer roosts are found in warm caves, often in karstic regions. Hibernacula are located in colder underground sites (usually large caves with a constant microclimate). The species is known to roost mainly in caves, but can use also artificial habitats (Mucedda *et al*., 2009). It is considered a sedentary species with the longest distance recorded of 94 km in Bulgaria; (Dietz *et al*., 2009a). *R. mehelyi* uses feeding strategies of hawking and fly catching prey close to vegetation (Gaisler, 2001c).

R. mehelyi, is one of six rhinolophid species occurring in Iran (DeBlase, 1980; Sharifi *et al.* 2000; Benda *et al*., 2012). This species is a Mediterranean bat species, but its range in Iran has a limited extent, and has not been recorded in the central, northern and north-eastern parts of the country (north-western Azarbaijan to central Fars) (DeBlase, 1980; Benda *et al*., 2012). *R. mehelyi*, was first recorded for Iran from Maku, west Azarbaijan Province (Etemad, 1963). Further records from different parts of the country were provided by Lay (1967), Farhang-Azad (1969), DeBlase (1972, 1980), Karami *et al.* (2008), Sharifi *et al.* (2000), Sharifi & Hemmati (2004), Sharifi (2004a), Akmali (2004) and Benda *et al.* (2012) who reported this bat from 14 localities in Iran.

This species is in decline throughout its range being close to extinction in France (Rodrigues & Palmeirim, 1999) and Romania (Botnariuc & Tatole, 2005). Based on Csősz *et al.* (2015), deforestation and high anthropic pressure are the main causes for decline in caves in South-Western Romania. It is also declining in southern Spain (Franco & Rodrigues, 2001), and the Russian Federation, Georgia, and Morocco (Dondini *et al*., 2014). There is also evidence on decline or eradication in caves that have been transformed to show cave for other purposes. According to the IUCN, *R. mehelyi* is Vulnerable (VU) (Alcaldé *et al*., 2016). In Iran, *R. mehelyi* is ranked as a very rare species (Sharifi *et al*., 2000). It is affected by disturbance and loss of underground habitats, changes in foraging habitats, and destruction of caves for tourism. Here, we present a review of earlier records of the species distribution in Iran and report new distribution records and information on echolocation calls for the Mehely's horseshoe bat.

MATERIAL AND METHODS

Study area

The Iranian basin is a large triangular depression in the ca. 1000 m.a.s.l., flanked by Elburz and Zagros Mts. This basin accommodates two large deserts. In the west, the Zagros Mts. extend diagonally from eastern Turkey to the north of the Persian Gulf and Pakistani border. These mountains act as barriers to the incoming clouds from the west and receive precipitations according to their altitude and longitude. In general, the northern and western regions receive considerably

more rainfall than those in the south and east. Most of the central and southern Zagros Mts. and the southern slope of the Elburz Mts. receive between 200 and 400 mm. Although some parts of the range may receive as much rainfall as 1000 mm per year the rest of the country has essentially no rainfall during the summer months.

Methods

Present survey was carried out from May 2014 to June 2016. Initially the list of caves was obtained from regional offices of Environment. Field studies targeted caves and crevices in the two Mountainous areas in western and northern and eastern parts of Iran. Caves representing different habitats in Iran were visited. (Appendix 1&2, Fig. 1). Searching the caves for bats occurred on 20 May 2014 (Zivieh cave); 9 June 2015 (Biboneh cave); 14 June 2015 (Kamtaran cave); 15 June 2015 (Gare tarik cave); 15 June 2015 (Ghaligeh cave); 16 June 2015 (Shoei cave); 17 June 2015 (Karaftu cave), 19 June 2015 (Sahulan cave); 20 June 2015 (Dehbouk cave); 2 October 2015 (Shabpareh cave); 4 October 2015 (Tadovan cave), 7 October 2015 (Shahpur cave), 19 June 2016 (Mahidasht cave), 9 May 2016 (Darvish Olia cave), 7 August 2016 (Sail mail cave), 6 May 2017 (Gharmabeh 3 cave), 25 May 2017 (Posht-e darband cave). All records were mapped and are summarized in Appendix1. Geographical position for each cave was recorded using a Garmin GPS unit (GPSMAP 60CSx; Garmin International, Inc., city, state, USA). Bats were netted with mist nets (6×3 m) placed on caves entrances or were collected using hand nets inside the caves. In addition, parameters such as air temperature and humidity were measured in the field and inside caves using a digital thermo-hydrometer.

R. mehelyi can be easily confused with *R. euryale* (Mucedda *et al*., 2009; Puechmaille *et al*., 2012). The most important distinguishing morphological characters are the narrow tip of the nasal leaf's lancet, straight profile of sella, and eyes separated from the edge of nose leaf when seen frontally and surrounded by a dark facial mask in *R. mehelyi* (Mucedda *et al*., 2009). *R. mehelyi* emits echolocation calls which on average show higher frequency than *R. euryale* but call frequency may overlap between the two bats, at least in mainland Europe (Russo *et al*., 2001; Salsamendi *et al*., 2005; Mucedda *et al*., 2009). *R. mehelyi* lancet is abruptly narrowed above the middle to a distinctly linear tip, allowing the distinction with *R. euryale* that has a lancet narrowing gradually to its tip, with only a slight constriction (Dietz & Von Helversen, 2004). In *R. mehelyi*, the eyes are distant from the noseleaf (Mucedda *et al*., 2009) while *R. euryale* has its eyes partially covered by the margin of the noseleaf (more specifically the cells of the lancet). *R. mehelyi* has darker hair around the eyes, however this trait alone is not sufficient for positive identification. In cases when differentiation between *R. eurayle* and *R. mehelyi* is not conceivably possible sequencing data recognizable based on the number of different nucleotide in sequences and also the genetic distance can be used to recognize the two species (Dietz, 2007). Seven External measurements including Head and Body Length (HB), Tail Length (TL), Forearm Length (FA), Ear Length (E), Fourth Digit Length (D4), Tibia Length (TBL), Length of Hind foot (HF) and Body mass (weight) were taken from live bats with a caliper (Sharifi & Akmali, 2006).

Echolocation calls were recorded by a Pettersson D240X Bat Detector (Pettersson Elektronik AB, Uppsala, Sweden; frequency response 10 to 120 kHz) with time expanded (10×). Echolocation calls were recorded from hand-held bats because this eliminates any possible Doppler shift compensation (Heller & von Helversen, 1989). Hand-held bats restrained motionless 10 cm in front of the bat detector (Petterson Ultrasound Detector D240x) connected to a MP3 recorder in the cave where the bats were captured. After recording, the bats returned to the cave where captured. Recorded Calls were analyzed with BatSound Pro software (Version 3.31, Pettersson EleKtronik AB, Uppsala, Sweden) using for analysis a sampling frequency of 44.1 kHz and a 1024 pt FFT with a Hamming window. The following four parameters were measured from each bat's call: start frequency (SF), end frequency (EF), Minimal frequency (MINF), Maximal frequency (MAXF),

peak frequency of the call which contained most energy (PF) and call duration (CD). CD (in millisecond; ms) was measured from the oscillogram, SF, EF, MINF and MAXF (kilohertz; kHz) were measured from a spectrogram, and PF (kHz) from power spectrum. At least 10 calls of each individual were chosen and a mean value for the calls was calculated in each stage and considered for analysis. Variations in all variables were presented as mean ± SD. Analyses were carried out with commercial statistics software (SPSS 6.0 and Excel 2013).

RESULTS

Distribution

The occurrence points of *R. mehelyi* reported since 2014 is shown in figure 1 and Appendix 1. From 24 localities of *R. mehelyi* reported here, 10 new localities are reported for the first time. All these new localities from are known from Zagros Mountains. No specimens are presented from large biogeographical units in the country such as deserts in the Iranian basin, Persian Gulf littorals and the Mesopotamian Plain, east and southeast terrains and southern Caspian Sea littoral. *R. mehelyi* was reported in mountainous area ranging from 1364 m.a.s.l in Mahidasht Cave, Kermanshah Province, and up to 2160 m.a.s.l in Darvish olia cave Kurdistan Province. We also reviewed literature and found about 14 other previously published records of the species in different regions of Iran (Fig. 1, Appendix 2).

All roosts with *R. mehelyi* in Iran were in natural caves. We report two nursery colonies from Mahidasht cave and Biboneh cave in western Iran. The breeding colony in Mahidasht cave (Kermanshah Province) included 100-150 bats of four species (*R. mehelyi*, *Miniopteros pallidus, Myotis blythii* and *Myotis capaccinii*) and nursery colony in Biboneh cave (Kermanshah Province) includeds two species (*R. mehelyi* and *Myotis blythii*). Bat associations involving the presence of various bat species with *R. mehelyi* is shown in Table 1. Large summer aggregations in caves often contain two or more bat species (*R. euryale* and *R. ferrumequinum* and *R. hipposideros*). Five bat species were found to share a roost with *R. mehelyi* in Dehbid, Ghaderabad (Fars Province) caves including *R. ferrumequinum*, *M. blythii, Rhinopoma muscatellum, R. euryale* and *Rousettus aegyptiacus*. In the Dehbouk cave (West Azerbaijan Province) we found *Miniopteros pallidus*, *M. blythii*, *R. ferrumequinum* and *R. hipposideros* along with *R. mehelyi*. We also, found *R. mehelyi* with *R. euryale* in the Shoei cave (Kurdistan Province). Two bat species were found to share a roost with *R. mehelyi* in Kamtaran cave (Kurdistan Province) *M. blythii* and *R. euryale*. In the Ghaligeh cave (Kurdistan Province) *R. mehelyi* found with *R. ferrumequinum*. In the Darvish olia cave (Kurdistan Province) *R. mehelyi* found to share a roost with *R. ferrumequinum, M. blythii* and *Miniopteros pallidus*.

Akmali (2004) has reported a colony of several hundred individuals of *R. mehelyi* in the Tange Rad cave at Aseman Abad (Ilam Province) on 14 October 2003, but no bat was found in this cave on 11 June, 2015. Also Hemmati (2001) observed *R. mehelyi* in the Zivieh cave on 23 July 2000, the Karaftu cave (both in Kurdistan Province) on 19 February 1998 and 16 April 1999, respectively, but no bat was found in this cave on 17 June 2015. Similarly, in the Shahpur cave, *R. mehelyi* was recorded to roost along with *Myotis capaccinii*, *Pipistrellus kuhlii* and *Miniopterus pallidus* in December 1962 (Lay, 1967; DeBlase, 1980) but no bat was found in this cave on 7 October, 2015 in this cave. Akmali *et al.* (2011a) also reported several co-occurring bat species in roosts of *R. euryale* such as *Rhinopoma microphyllum, R. muscatellum, Rhinolophus hipposideros, R. mehelyi, R. blasii, Myotis blythii, and Miniopterus pallidus* in the Tadovan cave, while were recorded only three species in the Tadovan cave (*R. euryale*, *Miniopterus pallidus, Rhinolophus hipposideros*) when visited this cave on 4 October 2015.

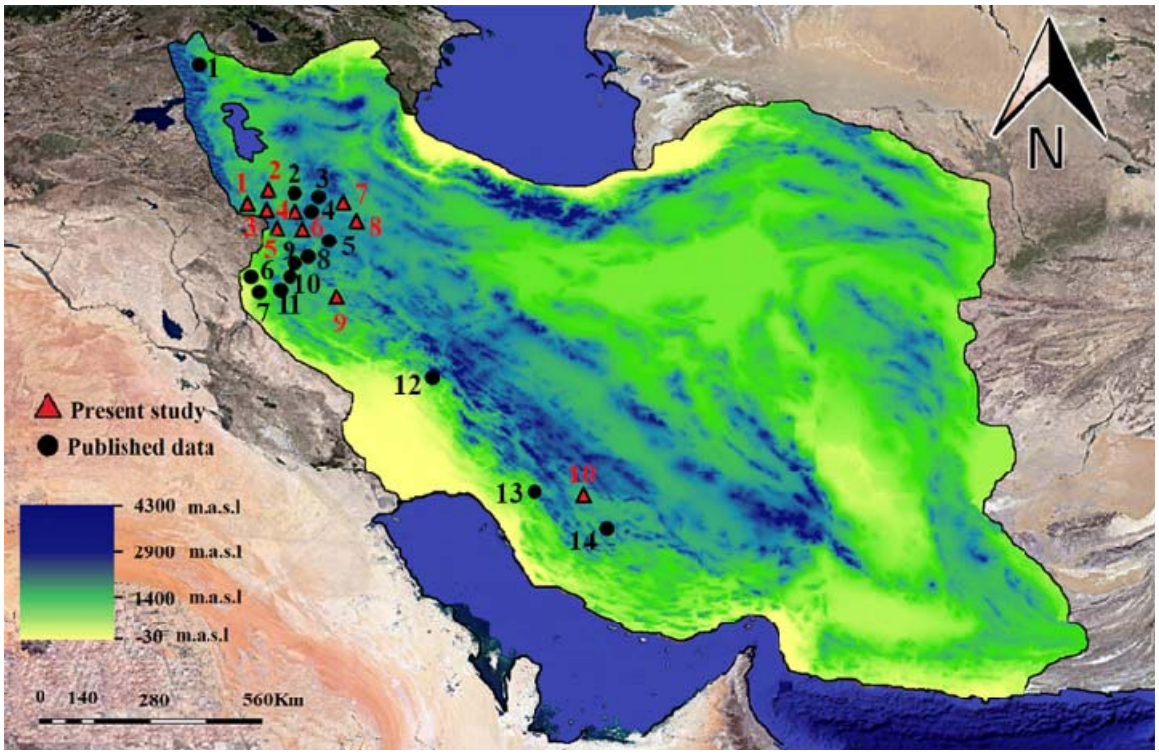

FIGURE 1. Geographical distribution of the *Rhinolophus mehelyi* in Iran. Records from this study (triangles) are summarized in Appendix 1, and published localities (circles) are in Appendix 2.

TABLE 1. Bats co-occurring with *R. mehelyi* in different caves of Iran. The locality numbers are similar to the numbers records presented from this study in the figure1.

No	Cave	Lat/N	Lon/E	R.. *mehelyi*	R.. *ferrumequinum*	R. *blasii*	R. *euryale*	*Myotis emarginatus*	*Rousettus aegyptiacus*	*Myotis blythii*	*Miniopterus pallidus*	*Myotis capaccinii*	*Rhinopoma muscatellum*
1	Shoei cave	36°00´	45°53´	+			+			+			
2	Sahulan cave	36°39´	44°57´	+			+						
3	Dehbouk cave	36°39´	44°57´	+	+			+		+			+
4	Darvish olia cave	35°37'	46°37'	+	+					+	+		
5	Sail mail cave	36°00'	47°35'	+									
6	Posht-e darband cave	36°05'	47°45'	+									
7	Kamtaran cave	36°01´	47°34´	+			+			+			
8	Ghaligeh cave	36°07´	47°55´	+	+								
9	Garmabeh3 cave	34° 05	47°26'	+									
10	Shabpareh cave	30°16´	53°10´	+	+	+	+		+	+			

TABLE 2. External measurement of Mehely's horseshoe bat from Dehbouk cave in west Azerbaijan Province, northwest Iran and from Ghaderabad, Shabpareh cave in Fars Province, south Iran. Data include number of individuals (n), mean (X) and standard deviation (sd).

	North Iran (Dehbouk cave)			South Iran (Shabpareh cave)			t-test	
	No	X	SD	No	X	SD	t	Sig.
Head and Body Length (HB)	12	49.91	4.62	14	51.76	2.83	0.417	0.680
Tail Length (TL)	12	30.40	2.60	14	27.43	1.43	-3.461	0.062
Forearm Length (FA)	12	52.40	0.41	14	51.31	0.87	-0.800	0.430
Ear Length (E)	12	22.80	0.75	14	22.46	0.80	-0.620	0.540
Length of Hind foot (HF)	12	9.80	0.20	14	10.04	0.64	1.973	0.058
Tibia Length (TBL)	12	22.50	1.11	14	22.20	1.07	-1.023	0.315
Fourth Digit Length (D4)	12	63.80	2.34	14	64.44	2.10	-1.237	0.226
Body mass (weight)	12	14.65	0.87	14	13.65	1.07	-0.970	0.397

Biometric data of *R.mehelyi* from two localities in the north and south of Iran, respectively, are shown in Table 2. There was no significant difference in external measurements between two localities in north and south of Iran.

R. mehelyi showed echolocation calls with a long constant-frequency part and calls contained 2 to 3 harmonics and the second harmonic contained most energy. The Power spectrogram and Sonogram for this species is seen in figure 2. *R. mehelyi* emits constant-frequency calls in the range 104.9–106.02 kHz in the present study for echolocation calls from north and south Iran. A considerable variation in this value was not observed within the range of Iran so that none of the four analyzed echolocation calls parameters showed significant differences between two regions of Iran (unpaired t -tests; $p > 0.05$ in all cases). Basic values of echolocation parameters are given in Table 3 for selected localities from Iran.

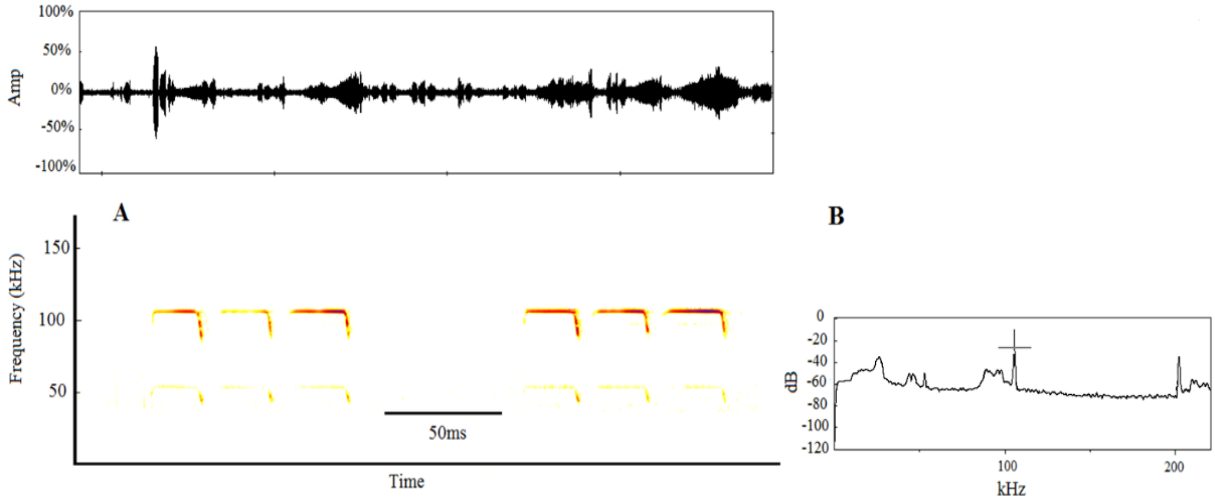

FIGURE 2. Echolocation calls of Mehely's horseshoe bats of Shabpareh cave in Fars Province from Iran. A) Power spectrogram, showing dominant frequency of the call; B) Sonogram, showing calls composed of frequency modulation (FM) component with a variable range of frequencies.

TABLE 3. Echolocation call variables with Mean ± SD from Mehely's horseshoe bats recorded from different localities in Iran.

Acoustic Parameter	South Iran N=18		North Iran N=24	
	X	p-value	X	p-value
Peak frequency (kHz)	106. 2±1.64	P > 0.5	104.9±0.68	P > 0.5
Call duration (ms)	22.93±3.69	P > 0.5	21.10±1.23	P > 0.5
Start frequency (kHz)	101.88±0.77	P > 0.5	99.70±0.72	P > 0.5
End frequency (kHz)	87.78 ± 0.78	P > 0.5	86.51±1.14	P > 0.5
Minimal frequency(kHz)	102.88±1.23	P > 0.5	101.88±0.77	P > 0.5
Maximal frequency(kHz)	108.85±0.98	P > 0.5	107.85±0.46	P > 0.5

DISSCUSSION

In the present study, we reviewed localities that had been previously published for distribution of the Mehely's horseshoe bat in Iran together with new distribution records obtained during 2014 – 2017. *R. mehelyi* is morphologically similar to *R. euryale* occurring in Iran. In order to avoid misidentification, we considered both morphometric measurements and echolocation records. The occurrence data for *R. mehelyi* show that this species is mainly distributed along the Zagros Mts (Fig. 1). *R. mehelyi* range in Iran has a rather limited extent; its records are apparently missing in the central, northern and north-eastern parts of the country, where other similar faunal types are present.

R. mehelyi showed echolocation calls with a long constant-frequency part in Iran. We observed patterns of intraspecific geographic variation in echolocation calls of *R. mehelyi* with peak frequency values ranging from 106. 2 kHz in south Iran to 104.9 kHz in north Iran (Fig. 1, Table 3). However, these differences are not significant. The obtained PF values (104.9–106. 2 kHz) in the present study for echolocation calls of *R. mehelyi* from Iran conform to a single echolocation sequence from Sinai, with the maximum energy of 105 kHz, which were preliminarily attributed to *R. mehelyi* by Benda *et al.* (2008). According to the data obtained from the European populations, *R. mehelyi* emits calls between 104–112 kHz (e. g Russo *et al.*, 2001; Salsamendi *et al.*, 2005; Siemers *et al.*, 2005; Papadatou *et al.*, 2008). Data on echolocation of this bat in the Asian part of its distribution range are available only from Israel, (Mendelssohn & Yom-Tov, 1999) mentioned similar values as known from Europe.

In the IUCN red list categories and criteria (IUCN, 2018), *R. mehelyi* is classified as Vulnerable (VU) (Alcaldé *et al.*, 2016). Sharifi *et al.* (2000) assessed conservation status of *R. mehelyi* in Iran as very rare species in a scale ranging from common, rare, very rare and extremely rare (Sharifi *et al.*, 2000). We present here 10 new localities for *R. mehelyi* in Iran but, also, this study highlights the fact that population of this species may be declining. There are evidences that show the bat population may have experienced a significant decline in caves in the study area. The land use alteration around and inside caves, increases in the number of dead guano compared with fresh guano, vandalisms in caves and impact of changing climate are among deleterious factors which may have affected bat populations in western Iran.

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Appendix 1. Distribution records of *R. mehelyi* resulting from present study. Locality numbers correspond to those shown in the distribution map of Iranian Mediterranean horseshoe bats in figure 1. Abbreviations: Alt = Altitude (meters above sea level), T = Temperature (Centigrade), H = Humidity

Present data: Locality 1- Shoei cave near baneh, Kurdistan Prov., 36°00´N 45°53´E, Alt: 1893, T = 21° C, H = 56%; **Locality 2-** Sahulan Cave, West Azerbaijan Prov., 36°39´N 44°47´E, Alt: 1763, T = 31° C, H = 68%; **Locality 3-** Dehbouk Cave, West Azerbaijan Prov., 36°39´N 44°57´E, Alt: 1610, T = 31° C, H = 68%; **Locality 4-** Darvish Olai cave, Kurdistan Prov., 35°37'N46°37'E; Alt: 2160, T = 17° C, H = 78%. **Locality 5-** Sail Mail cave, Kurdistan Prov., 36°00´N47°35´E; Alt: 1642, T = 23° C, H = 53%. **Locality 6-** Posh-e Darband cave, Bijar, Kurdistan Prov., 36°08´N47°41´E; Alt: 1621, T = 29° C, H = 51%. **Locality 7-** Kamtaran Cave, Kurdistan Prov., 36°01´N 47°34´E, Alt: 1782; **Locality 8-** Ghalijeh cave, Kurdistan Prov., 36°07´N47°55´E; Alt: 1300, T = 23° C, H = 58%, T = ° C, H = %; **Locality 9-** Garmabe3 cave, Noor abad, Lorestan Prov., 34°05´N47°26´E; Alt: 1270, T = 29° C, H = 47%. **Locality 10-** Shabpareh cave, Ghaderabad, Dehbid. Fars Prov., 30°16´N 53°10´E, Alt: 2066 T = 32° C, H = 19.5%.

Appendix 2. Published records of *R. mehelyi* that has been earlier published are referenced (Lay, 1967; DeBlase, 1972, 1980; Hemmati, 2001; Sharifi & Hemmati, 2001; Sharifi & Hemmati, 2004; Akmali, 2004; Akmali *et al*., 2011a) The locality numbers correspond to the numbers shown in the distribution map of Iranian Mediterranean horseshoe bats in figure 1. Abbreviations: Alt = Altitude (meter).

Review data: Locality 1- Maku cave, West Azerbaijan Prov., in the mountain south of Zangmar River, 27 September, 2 and 6 October 1962: 39°18´N 44°31´E; **Locality 2-** Karaftu cave, Kurdistan Prov., 45 km NW Divandarreh (Hemmati, 2001), , 36° 20' N, 46° 53' E, Alt: 2040; **Locality 3-** Zivieh cave, Kurdistan Prov., 40 km E Saqqez, Zivieh cave, 23 July 2000 (Hemmati, 2001), 36° 17' N, 46° 43' E, Alt: 1850; **Locality 4-** Gara Tarik, Kurdistan Prov., about 4 km. N Qareh, 13 August 1968 (DeBlase, 1972, 1980), 24, 36°07´N, 47°55´E; **Locality 5-** Aftabi cave, Kordestan Prov., 24 July 2000 (Hemmati, 2001), 35° 50' N, 47° 40' E; **Locality 6-** Kilasefid cave, Kermanshah Prov., 30 km NE Qasr-e Shirin, , 1 September and 19 October 1999, 9 July 2000 (Hemmati, 2001; Sharifi & Hemmati, 2001; Sharifi & Hemmati, 2004), 34° 40' N, 45° 52' E; **Locality 7-** Dakal cave, Kermanshah Prov., near Sar Pol-e Zahab, October 2003 (Akmali, 2004) 34° 27' N, 45° 52' E, Alt:551; **Locality 8-** Biboneh cave , Kermanshah Prov., 60 km NE Eslam Abad (Akmali, *et al.* 2011a), 34° 29' N, 46° 58' E. **Locality 9-** Mahidasht Cave, Kermanshah Prov, 30 km SW Kermanshah, 7 June 2000 (Hemmati, 2001), 34° 16' N, 46° 48' E, Alt: 1364; **Locality 10-** Sharif Abad cave, Kermanshah Prov., 5 km S Eslam Abad (Akmali *et al*., 2011a), 34° 05' N, 46° 32' E; **Locality 11-** Aseman Abad cave, Ilam Prov., 30 km N, Tange Rad cave, 14 October 2003 (Akmali, 2004), 33° 53' N, 46° 24' E, Alt: 1235; **Locality 12-** Shah Abbas Caves, Chahar-Mahal-e Bakhtiari Prov., Kuh Rang, 1965 (Lay, 1967; DeBlase 1972, 1980), 32°18´N 50°13´E; **Locality 13-** shapur, Fars Prov, 19 km NW of Kazerun, large cave above the Sasan spring, (Lay, 1967 [as *R. euryale*]; Etemad, 1969 [as *R. euryale*]; DeBlase, 1972), 29°48´N 51°37´E; **Locality 14-** Tadovan cave, Fars Prov., 44 km NW of Jahrom (Akmali *et al*., 2011a), 28°51´N 53°20´E.