

Range extension and morphology of the Italian wall lizard, *Podarcis siculus* (Rafinesque-Schmaltz, 1810) (Squamata: Lacertidae), from Turkey

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Abstract: A record of the Italian wall lizard, *Podarcis siculus* (Rafinesque-Schmaltz, 1810), from Atakum (Samsun, Central Black Sea Region) is provided in this study. In addition, 5 specimens (3 ♂♂ and 2 ♀♀) from Atakum (Samsun) and 14 specimens (7 ♂♂ and 7 ♀♀) from Gelibolu (Çanakkale, Thrace), with records provided recently, were evaluated in terms of measurements, pholidosis, and color and pattern. With the record from Samsun, the Italian wall lizard's distributional range has been extended about 360 km eastwards. The specimens examined from both localities were determined to resemble *P. s. hieroglyphicus* (Berthold, 1840), distributed in Thrace and Anatolia. Moreover, some information on the breeding biology of the specimens is provided.

Key words: *Podarcis siculus*, distribution, Thrace, Black Sea region, Turkey

1. Introduction

The wall lizards, *Podarcis* Wagler, 1830, comprise 21 currently recognized species (Speybroeck et al., 2010) and occur in Europe, North Africa, and North America. Most species are restricted to the Mediterranean basin (Harris, 1999; Harris and Arnold, 1999; Speybroeck et al., 2010; Silva-Rocha et al., 2012). Although the Italian wall lizard, *Podarcis siculus* (Rafinesque-Schmaltz, 1810), is naturally distributed throughout the Italian Peninsula and Sicily, it has been substantially introduced worldwide (Silva-Rocha et al., 2012). It has been suggested that the species has been carried to the Tyrrhenian Islands, Corsica, Sardinia, Switzerland, and the islands and coastal areas of the eastern Adriatic Sea (Slovenia, Croatia, Bosnia and Herzegovina, and Montenegro) either in historical times or recently (Corti, 2006; Isailovic et al., 2009). Furthermore, *P. siculus* has been introduced to the Iberian Peninsula (Spain and Portugal), southern France, Turkey, North Africa (Tunisia and Libya), and the United States (Philadelphia, Kansas, and New York) (Isailovic et al., 2009; Silva-Rocha et al., 2012). The species is a successful colonizer, as it has been introduced and has adapted to places outside its range (Capula and Ceccarelli, 2003).

P. siculus is a polytypic species, and it has high morphological, color, and pattern variability throughout its range (Arnold and Oven, 2002). The 91 described

subspecies of the species were reviewed by Henle and Klaver (1986), and 52 of them were accepted, while 47 of them were endemic to a single island. *P. s. hieroglyphicus* was first described by Berthold (1840) from İstanbul (Turkey). Later on, the species was reported to inhabit some islands in the Marmara Sea, İstanbul (the European and Asian sides) (Bird, 1936; Bodenheimer, 1944; Başoğlu and Baran, 1977; Çevik, 1999; Jablonski and Stloukal, 2012), Bursa (Uğurtaş et al., 2000; Mollov, 2009), Mt. Ida (Hür et al., 2008), Zonguldak (Ilgaz et al., 2013), and Gelibolu (Tok and Çiçek, 2014). In this study, a new record of the species outside its distributional range is provided. We also aimed to evaluate the specimens caught from both the new locality and those recently recorded from Gelibolu (Çanakkale) (Tok and Çiçek, 2014) in terms of their pholidosis, morphometric characters, and color and pattern features. In addition, we convey some information on the breeding biology of the species, which has not been widely known in Turkey.

2. Materials and methods

During herpetological studies conducted in the Central Black Sea Region in 2011, a population of *P. siculus* was observed around the building of the District Directorate for Food, Agriculture, and Livestock in the district of Atakum (Samsun Province, 41.332474°N, 36.286102°E,

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sea level) on 4 May 2011. A total of 5 individuals (3 ♂♂ and 2 ♀♀) were caught from Atakum. These specimens from the new locality and 14 (7 ♂♂ and 7 ♀♀) specimens from Gelibolu (Çanakkale Province, 40.408188°N, 26.663484°E, 8 m a.s.l.) first recorded by Tok and Çiçek (2014) were evaluated in terms of pholidosis, morphometric characters, and color and pattern in detail. The mensural and meristic characters were evaluated according to Çevik (1999), Uğurtaş et al. (2000), and Ilgaz et al. (2013). All measurements and counting were done under a stereomicroscope, and a digital caliper sensitive to 0.01 mm was used for the measurements. The specimens are deposited in the museum of the Faculty of Arts and Sciences, Onsekiz Mart University, and incorporated into the collection of ZDEU-COMU (Department of Zoology at Ege University-Çanakkale Onsekiz Mart University). The sexes and populations were compared with a nonparametric Mann-Whitney U test due to the data not being normally distributed. The statistical analyses were performed using the PAST statistical program (Hammer et al., 2001). The alpha level was set at 0.05. The means are provided with their standard deviations (SDs).

3. Results

P. siculus was observed around the parking lot of the building belonging to the District Directorate for Food, Agriculture, and Livestock in Atakum (Samsun) (Figures 1 and 2). The area is at a distance of about 5 m from the Black Sea coast. There are a few trees in the area. The individuals were generally observed while they were sunbathing on the walls of the building and the garden. The Gelibolu population (Thracian part of Çanakkale) was observed on lumber in the vicinity of the industrial site, which was quite close to the settlement, on the walls of stone houses in the vicinity, and on garden walls. The morphological values of the 19 (10 males and 9 females) specimens caught from both localities are as follows.

Material: ZDEU-COMU 68/2011, 3 ♂♂, 2 ♀♀, 04.05.2011, Atakum/Samsun, Leg. Y. Tayhan, A. Kaldırım.

Pholidosis: The supraciliary plates are 6/6 (left/right) in 4 specimens (80%) and 6/7 in 1 specimen under examination (20%). In all specimens examined, the supraocular plates and the supralabial plates in the anterior part of the subocular are 4/4, and the postnasal plates are 1/1. The masseteric plates are 2/1 in 2 specimens (40%) and 1/2 (20%), 1/1 (20%), and 2/2 (20%) in the others. The



Figure 1. The current distribution of *P. siculus* in Turkey. Circles show the known records of the literature cited in the text, and squares indicate Gelibolu and Atakum.

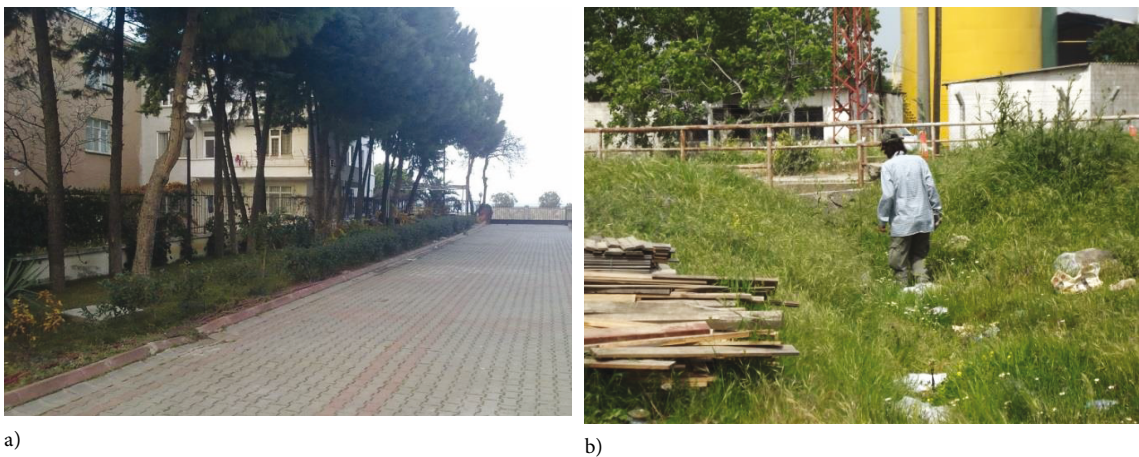


Figure 2. A general view of the habitats from (a) Atakum (Samsun) and (b) Gelibolu (Çanakkale), where the specimens of *Podarcis siculus* were found.

inframaxillary plates, the last of which is generally smaller than the others, are 6/6 in 4 specimens (80%) and 6/5 in 1 specimen (20%). The collaria are 12 in 2 specimens (40%), 11 in 2 specimens (40%), and 10 in 1 specimen (20%). The longitudinal number of the ventralia is 6 in all specimens. The supratemporal plates are 4/4 in 4 specimens (80%) and 3/4 in 1 specimen (20%), and there is/are 1 or 2 more small scale(s)/plate(s) touching the parietal plates behind the large plates. The numbers of preanal plates surrounding the

anal plate are 6 in 3 specimens (60%) and 7 in 2 specimens (40%). The values for the other pholidosis characteristics of the specimens are presented in Table 1.

Morphometrics: In the specimens under examination, the snout-vent length (SVL) is in the range of 37.57–80.55 mm, with the mean value being 61.13 mm (SD = 17.63). The pileus length is more than 2-fold its width. The values for the other body measurements and ratios of the specimens are provided in Table 2.

Table 1. Summary statistics of pholidosis of *Podarcis siculus* specimens from Atakum (Samsun) and Gelibolu (Çanakkale). N: Number of specimens; M: mean; SD: standard deviation; SE: standard error of the mean; SprC–L/R: supraciliary granules–left/right; MG: transversal series of gular scales between inframaxillary symphysis and collar; C: collar; FP–L/R: femoral pores–left/right; SubdgtL–L/R: subdigital lamellae under the fourth toes of the hind limbs–left/right.

	SprC–L	SprC–R	MG	Co	FP–L	FP–R	SubdgtL–L	SubdgtL–R	Dorsalia	Ventralia
Samsun (♂♂ + ♀♀)										
N	5	5	5	5	5	5	5	5	5	5
M	10.40	9.20	27.40	11.20	25.60	25.80	32.40	33.00	69.40	27.20
SD	1.517	0.837	1.673	0.837	1.140	1.095	0.894	1.871	2.408	1.304
Min	8.00	8.00	26.00	10.00	24.00	25.00	32.00	31.00	66.00	26.00
Max	12.00	10.00	30.00	12.00	27.00	27.00	34.00	36.00	72.00	29.00
SE	0.678	0.374	0.748	0.374	0.510	0.490	0.400	0.837	1.077	0.583
Median	11.00	9.00	27.00	11.00	26.00	25.00	32.00	33.00	70.00	27.00
Gelibolu (♂♂)										
N	7	7	7	7	7	7	7	7	7	7
M	11.00	10.29	28.86	10.86	23.71	23.86	33.43	33.29	74.29	25.71
SD	1.528	1.799	1.574	0.690	0.951	0.900	2.370	1.799	2.690	0.951
Min	9.00	7.00	26.00	10.00	22.00	23.00	30.00	31.00	70.00	25.00
Max	13.00	12.00	31.00	12.00	25.00	25.00	37.00	36.00	77.00	27.00
SE	0.577	0.680	0.595	0.261	0.360	0.340	0.896	0.680	1.017	0.360
Median	11.00	11.00	29.00	11.00	24.00	24.00	34.00	33.00	75.00	25.00
Gelibolu (♀♀)										
N	7	7	7	7	7	7	7	7	6	7
M	10.00	10.71	29.00	10.86	24.00	24.57	33.57	33.57	71.00	28.71
SD	1.528	1.113	1.000	0.378	1.155	0.787	1.718	0.976	1.414	0.951
Min	8.00	9.00	28.00	10.00	22.00	24.00	31.00	32.00	69.00	27.00
Max	12.00	12.00	30.00	11.00	25.00	26.00	36.00	35.00	73.00	30.00
SE	0.577	0.421	0.378	0.143	0.436	0.297	0.649	0.369	0.577	0.360
Median	10.00	11.00	29.00	11.00	24.00	24.00	34.00	34.00	71.00	29.00
Gelibolu (♂♂ + ♀♀)										
N	14	14	14	14	14	14	14	14	13	14
M	10.50	10.50	28.93	10.86	23.86	24.21	33.50	33.43	72.77	27.21
SD	1.557	1.454	1.269	0.535	1.027	0.893	1.990	1.399	2.713	1.805
Min	8.00	7.00	26.00	10.00	22.00	23.00	30.00	31.00	69.00	25.00
Max	13.00	12.00	31.00	12.00	25.00	26.00	37.00	36.00	77.00	30.00
SE	0.416	0.389	0.339	0.143	0.275	0.239	0.532	0.374	0.752	0.482
Median	10.50	11.00	29.00	11.00	24.00	24.00	34.00	33.50	72.00	27.00

Table 2. Summary statistics of morphometric measurements (in millimeters) and ratios of *Podarcis siculus* specimens from Atakum (Samsun) and Gelibolu (Çanakkale). SVL: Snout-vent length; TL: tail length; TBL: total body length; PL: pileus length; PW: pileus width; HL: head length; HW: head width; HD: head depth.

	SVL	TL	TBL	PL	PW	HL	HW	HD	PL/PW	PL/SVL	PW/SVL	HL/HW	TL/SVL
Samsun (♂♂ + ♀♀)													
N	5	3	3	5	5	5	5	5	5	5	5	5	3
M	61.13	126.00	192.40	14.51	6.18	15.30	9.14	6.85	2.34	0.24	0.10	1.69	1.88
SD	17.629	39.000	55.248	3.961	1.543	4.180	2.909	2.112	0.137	0.021	0.009	0.092	0.146
Min	37.57	87.00	135.27	9.65	4.38	10.27	5.62	4.24	2.18	0.21	0.09	1.58	1.79
Max	80.55	165.00	245.55	20.24	8.28	21.43	13.53	9.85	2.47	0.26	0.12	1.83	2.05
SE	7.884	22.517	31.897	1.771	0.690	1.870	1.301	0.944	0.061	0.009	0.004	0.041	0.084
Gelibolu (♂♂)													
N	7	2	2	7	7	7	7	7	7	7	7	7	2
M	64.42	138.00	202.10	15.95	6.90	16.47	9.71	7.30	2.30	0.25	0.11	1.70	2.15
SD	9.402	1.414	0.127	2.454	0.767	2.181	1.170	1.101	0.136	0.006	0.007	0.094	0.074
Min	52.73	137.00	202.01	12.95	5.78	13.87	8.12	5.78	2.11	0.24	0.10	1.58	2.10
Max	77.46	139.00	202.19	19.38	7.92	19.44	11.32	9.01	2.52	0.25	0.12	1.86	2.21
SE	3.554	1.000	0.090	0.928	0.290	0.824	0.442	0.416	0.051	0.002	0.003	0.036	0.052
Gelibolu (♀♀)													
N	7	4	4	7	7	7	7	7	7	7	7	7	4
M	59.31	110.75	166.68	13.13	5.95	13.80	7.89	5.99	2.21	0.22	0.10	1.75	1.99
SD	8.519	8.958	13.534	1.234	0.631	1.404	0.750	1.014	0.070	0.014	0.007	0.106	0.188
Min	50.50	98.00	150.66	11.47	5.31	12.08	6.98	4.73	2.13	0.21	0.09	1.65	1.80
Max	71.21	117.00	181.82	15.05	7.08	16.11	8.93	7.58	2.31	0.24	0.11	1.90	2.20
SE	3.220	4.479	6.767	0.467	0.239	0.531	0.283	0.383	0.026	0.005	0.003	0.040	0.094
Gelibolu (♂♂ + ♀♀)													
N	14	6	6	14	14	14	14	14	14	14	14	14	6
M	61.87	119.83	178.49	14.54	6.42	15.13	8.80	6.64	2.26	0.24	0.10	1.72	2.05
SD	9.018	15.702	21.081	2.369	0.837	2.244	1.334	1.222	0.114	0.016	0.007	0.100	0.171
Min	50.50	98.00	150.66	11.47	5.31	12.08	6.98	4.73	2.11	0.21	0.09	1.58	1.80
Max	77.46	139.00	202.19	19.38	7.92	19.44	11.32	9.01	2.52	0.25	0.12	1.90	2.21
SE	2.410	6.410	8.606	0.633	0.224	0.600	0.357	0.327	0.031	0.004	0.002	0.027	0.070

Color and pattern: In both sexes, the top of the head is brownish. The lateral sides of the head, particularly the supralabials, are greenish. The ground color of the dorsum is greenish on up to half of the body, and the rest of the body, the tail, and the hindlimbs are brownish (Figure 3a). There are spots that form an indistinct greenish reticulated pattern in the adult male and in 2 females. In 2 young

males, however, these spots are spheroidal and obvious and do not fully form a reticulated structure (Figure 3b). The lateral sides of the body are in shades of brown and contain spheroidal green spots. The lower part of the head and the ventral side are light greenish and grayish. There are round greenish or bluish spots on the outer ventral plates.

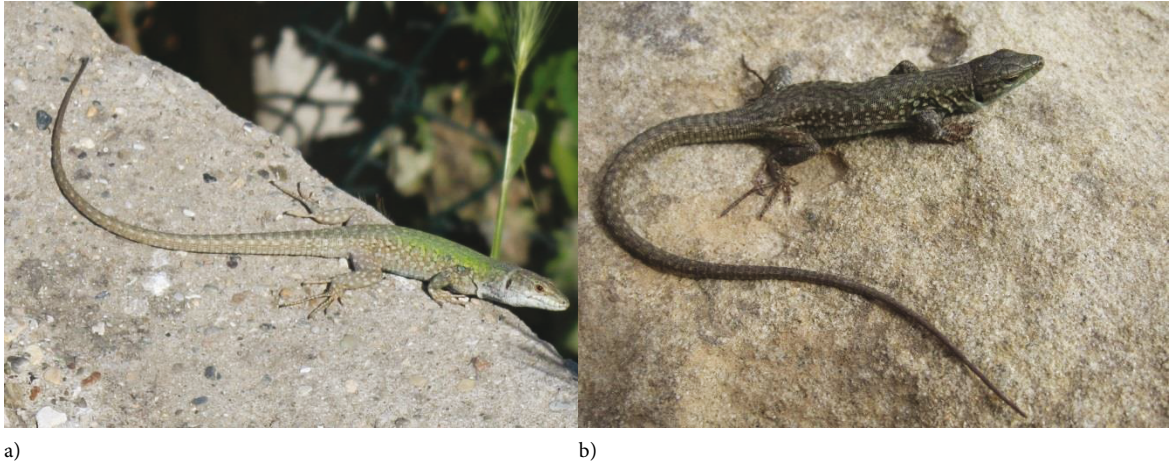


Figure 3. A general view of *Podarcis siculus* (a: from Gelibolu and b: from Atakum).

Material: ZDEU-COMU 07/2012, 7 ♂♂, 7 ♀♀, 04.05.2013, Gelibolu/Çanakkale, Leg. C. V. Tok, B. Y. Yakın.

Pholidosis: The supraciliary plates are 6/6 in 11 specimens (79%) and 5/5, 5/6, and 7/5 in the others (each 7%) under examination. In all specimens examined, the supraocular plates are 4/4. The supralabial plates in the anterior part of the subocular are 4/4 in 13 specimens (93%) but 5/4 in 1 specimen (7%). The postnasal plates are 1/1 in 13 specimens (93%) and 1/2 in 1 specimen (7%). The masseteric plates are 1/1 in 7 specimens (50%), 2/1 in 3 specimens (21%), 2/2 in 3 specimens (21%), and 3/1 in 1 specimen (7%). The inframaxillary plates, the last of which is generally smaller than the others, are 6/6 in 11 specimens (79%), 6/7 in 2 specimens (14%), and 5/6 in 1 specimen (7%). The collars are 11 in 10 specimens (71%), 10 in 3 specimens (21%), and 12 in 1 specimen (7%). The longitudinal number of the ventralia is 6 in all specimens. The supratemporal plates are 4/4 in 4 specimens (29%), 4/3 in 3 specimens (21%), 3/4 in 3 specimens (21%), 3/5 in 2 specimens (14%), 4/5 in 1 specimen (7%), and 2/3 in 1 specimen (7%), and there is/are 1 or 2 more small scale(s)/plate(s) touching the parietal plates behind the large plates. The number of preanal plates surrounding the anal plate is 7 in 7 specimens (50%), 6 in 6 specimens (43%), and 5 in 1 specimen (7%). The descriptive statistical values for the other pholidosis characteristics of the specimens are provided in Table 1.

Morphometrics: The SVL values were measured as 64.42 mm (SD = 9.402) in males and as 59.31 mm (SD = 8.519) in females. The tail length (TL) value is about 2-fold the SVL. Likewise, the pileus length (PL) value is more than 2-fold the pileus width (PW) (Table 2).

Color and pattern: The top of the head is brownish and the lateral sides of the head, particularly the supralabials, are greenish in our specimens. In most of the specimens, the coloration of the dorsum is generally light greenish on up to half of the body, and the rest of the body, the tail, and the hindlimbs are in brownish shades (Figure 3a). In 2 female individuals and a male individual, the shades of green on the dorsum are rather indistinct, while the shades of brown are more dominant (Figure 3b). There are spots that form an indistinct green reticulated pattern on the dorsal side. However, no maculation on the dorsum was observed in 3 male and 3 female individuals. In all samples, the lateral sides of the body are in shades of brown and contain spheroidal green spots. The lower part of the head and the ventral side are light greenish, grayish, or off-white. Moreover, there are round greenish or bluish spots on the outermost row of the ventral plates.

In the Gelibolu (Çanakkale) population, the number of dorsalia was found to be higher in males; nevertheless, the number of ventralia was found to be lower than that of females (Mann-Whitney U test, $M - W = 1.50$, $P \leq 0.001$). Regarding the body measurements, the SVL ($P \geq 0.05$), the PL ($M - W = 6.00$, $P \leq 0.017$), the PW ($M - W = 7.00$, $P \leq 0.026$), the head length (HL; $M - W = 7.00$, $P \leq 0.026$), the head width (HW; $M - W = 4.00$, $P \leq 0.053$), and the head depth (HD; $M - W = 9.00$, $P \leq 0.007$) were found to be higher in males than in females. When the populations were compared, the specimens of Gelibolu were found to have slightly lower values than the specimens of Samsun in terms of the number of femoral pores (FPs; Mann-Whitney U test, $M - W = 9.00$, $P \leq 0.014$). In addition, the dorsalia number of the Samsun population was higher than that of the Gelibolu specimens ($M - W = 12.00$, $P \leq 0.042$).

Biological observations: Among the specimens caught and dissected in the same periods in a 1-year interval, 17 eggs with miscellaneous dimensions were detected in 1 of 2 female specimens caught from Samsun, while 21 eggs with miscellaneous dimensions were determined in the other female. Eggs with miscellaneous dimensions (between 16 and 29 eggs) were detected in the bodies of 3 of 7 female specimens collected from Gelibolu (Çanakkale) coincidentally on the same date 1 year later. It was concluded that the species was active in both regions (Çanakkale and Samsun) in terms of breeding in early May.

4. Discussion

Although the coloration of the dorsum of *P. s. hieroglyphicus* is especially highly variable, it is distinguished by the fact that the spots on the dorsum form a reticulated structure (Başoğlu and Baran, 1977). When the specimens are evaluated in terms of pholidosis, morphological characters, and color and pattern, they are generally in agreement with the data given by Bird (1936), Başoğlu and Baran (1977), Çevik (1999), Uğurtaş et al. (2000), and Ilgaz et al. (2013).

All of the morphological, meristic, and color and pattern features of the Gelibolu and Samsun specimens were generally in accordance with the values given in previous studies on *P. s. hieroglyphicus* (Table 3). Additionally, the values obtained in terms of the numbers of subdigital lamellae were in agreement with those of

Çevik (1999), Uğurtaş et al. (2000), and Ilgaz et al. (2013), whereas they were found to be higher when compared with those of Bird (1936).

Even though *P. siculus* is naturally distributed on the Italian Peninsula and in Sicily, it has also been distributed to Europe, Anatolia, North Africa, and North America through human means, particularly via maritime transportation (Isailovic et al., 2009; Silva-Rocha et al., 2012). The observation of the species in Anatolia, with no connection to its distributional range, supports anthropogenic carriage (Başoğlu and Baran, 1977). When the distribution map of *P. siculus* is considered, it is seen that there are records from seaport cities in particular (Figure 1). Both the Atakum (Samsun) and the recently detected Gelibolu (Thracian part of Çanakkale) populations (Tok and Çiçek, 2014) are in regions that are quite close to ports. With this new record, the distributional range of the species has been extended about 360 km eastwards. On the other hand, only with phylogenetic analyses would it be possible to clarify how long ago these detected populations split from the main population. The mitochondrial DNA study conducted on the populations of the Iberian Peninsula and the Balearic Islands made it possible to evaluate the times of the splitting of the populations and the populations from which they had split (Silva-Rocha et al., 2012). There is also an urgent need for detailed molecular studies to be conducted on the Anatolian populations.

It was observed that the Gelibolu and Atakum populations of *P. siculus* lay 16 to 29 eggs; miscellaneous

Table 3. Comparison of meristic (left side of the body) and metric characters of our populations with those given by Bird (1939), Çevik (1999), Uğurtaş et al. (2000), and Ilgaz et al. (2013). N: Number of specimens; range: extreme values.

Characters	Bird (1939)			Çevik (1999)			Uğurtaş et al. (2000)			Ilgaz et al. (2013)			Present study - Gelibolu			Present study - Samsun		
	N	Mean	Range	N	Mean	Range	N	Mean	Range	N	Mean	Range	N	Mean	Range	N	Mean	Range
SprC				42	9.2	7–12	6	10.2	9–11	6	10.2	9–11	14	10.5	8–13	5	10.4	8–12
MG	6	28.33	26–31	41	29.4	25–34	6	28.0	27–30	6	28.0	27–30	14	28.9	26–31	5	27.4	26–30
Co	6	10.67	10–11	42	11.1	10–13	6	11.8	11–13	6	11.8	11–13	14	10.9	10–12	5	11.2	10–12
FP				42	24.1	21–27	6	24.7	22–26	6	24.7	22–26	14	23.9	22–25	5	25.6	24–27
SubdgtL	6	27.67	24–31	42	32.6	26–36	6	31.2	30–32	6	31.2	30–32	14	33.5	30–37	5	32.4	32–34
Dorsalia	6	69.67	64–76	43	71.8	62–80	6	71.5	69–74	6	71.5	69–74	13	72.8	69–77	5	69.4	66–72
Ventralia (♂♂)				18	26.0	25–28	4	26.5	25–28	4	26.5	25–28	7	25.7	25–27			
(♀♀)				14	28.8	27–30	2	28.5	28–29	2	28.5	28–29	7	28.7	27–30			
(♂♂ + ♀♀)	6	27.83	26–29							6	11.8	11–13	14	27.2	25–30	5	27.2	26–29
PL/SVL				20	0.3	0.25–0.28	2	0.3	0.26–0.27	2	0.3	0.26–0.27	14	0.24	0.21–0.25	5	0.24	0.21–0.26

dimensions were detected when the eggs were counted. Depending on their size, the females lay up to 5 clutches of eggs ranging in number from 2 to 12 eggs (generally 5–6) each (Guntram et al., 2010). Baran and Atatür (1998)

and Baran et al. (2013) reported that females lay 3 to 12 eggs each year. Eggs hatch in 5–7 weeks and hatchlings are 3–3.5 cm in SVL. This implies that the fecundity of Turkish populations is up to 29 eggs each year.

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