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Allochthonous species of Turtles in Croatia and Bosnia and Herzegovina

Strane vrste kornjača u Hrvatskoj i Bosni i Hercegovini

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Abstract

The release of reptiles imported for pet trade, by their owners, over decades has caused allochthonous species to become widespread in natural habitats all over the World. The turtles are among the most popular reptiles in the pet trade. There are reports of the presence of one allochthonous species of turtle (*Trachemys scripta*) on the Balkan Peninsula for the past 20-30 years. The presence of *Pelodiscus sinensis*, in Croatia was officially published in 2014 and the presence of *Graptemys pseudogeographica kohnii* has been known since 2006 but not scientifically published. We gathered data on distribution and presence of *Trachemys scripta elegans, Trachemys scripta scripta, G. p. kohnii, G. p pseudogeographica.* and *P. sinensis* and produced the distribution map which shows heterogeneity in terms of rural/urban territories. The single largest allochtonous population (mostly comprised of *T. scripta*) in Croatia is found in Maksimir park (city of Zagreb) numbering over 300 individuals.
Key words: allochthonous, turtles, distribution, Croatia, Bosnia and Herzegovina

Sažetak

Alohtone vrste gmazova postale su tijekom posljednjih godina normalna pojava u prirodnim staništima diljem Svijeta kao posljedice puštanja jedinki uzgojenih i uvezenih za trgovinu kućnim ljubimcima. Upravo kornjače su jedna od najpopularnijih grupa gmazova u trgovini kućnim ljubimcima. Prve pouzdane bilješke o uvozu i prisutnosti alohtonih vrsta kornjača (*Trachemys scripta*), na području Balkanskog poluotoka, potječu od prije 20 - 30 godina. Prvi nalazi o prisutnosti *Pelodiscus sinensis*, u Hrvatskoj, potječu iz 2014. godine a podatci o prisutnosti *Graptemys pseudogeographica kohnii* neslužbeno su poznati još od 2006. godine ali nisu bili objavljeni. Ovim radom okupili smo sve dostupne i nove podatke o rasprostranjenosti *Trachemys scripta elegans, Trachemys scripta scripta, G. p. kohnii, G. p pseudogeographica.* i *P. sinensis*, te izradili nove precizne karte distribucije. Podatci ukazuju na heterogenost nalaza u odnosu na ruralna/urbana područja. Najveća pojedinačna populacija alohtonih kornjača (uglavnom sačinjena od *T. scripta*) u Hrvatskoj nalazi se u gradskom parku u Maksimiru (grad Zagreb) koja broji preko 300 jedinki.
Ključne riječi: alohtone, kornjače, rasprostranjenost, Hrvatska, Bosna i Hercegovina

INTRODUCTION

Biological invasions have taken place since prehistoric times but today with a much higher rate it has became a global issue and through mass invasion can lead to global species homogenization (Ricciardi 2007, Kraus 2009). For

years biologists have been pointing out that biological invasion is a serious threat for biodiversity, ecosystem services, the economy and human health (Mooney & Hobbs 2000, Sandlund et al. 2001, Pejchar & Mooney 2009, Kopecký et al. 2013). Not only that, invasive species can influence the native fauna through interspecific and intraspecific interactions, there are also examples of invasive species altering the evolutionary traits of native species (Mooney & Hobbs 2000). The first step of biological invasion is the introduction of a species to a new environment (Shea & Chesson 2002, Kraus 2009) so it is very important to have data on allochthonous species in the natural habitat. The allochthonous reptiles through decades of pet trade have become widespread in almost all parts of the World and in many types of habitats (Ficetola 2008).

The turtles are among the most popular pet reptiles in trade and *Trachemys scripta* (Schoepff, 1792) is almost certainly the most popular species among the turtles (Kraus 2009, Kopecky et al. 2013). The pond slider turtles, with three subspecies, *T. s. scripta* (Schoepff, 1792), *T. s. elegans* (Wied-Neuwied, 1839) and *T. s. troostii* (Holbrook, 1836), are native to south-eastern United States but are captive bred around the World. Through decades of a massive pet trade and uncontrolled release in nature *T. scripta* has become the most commonly introduced and therefore the most widespread turtle species in the World (Ficetola et al. 2008, Ernst & Lovich 2009, Kraus 2009, Kopecký et al. 2013). As an alien species it is already present in 29 European countries (Ficetola et al. 2012). In some of them reproduction has also been recorded but with variable success: Austria, Italy, Spain, France and Slovenia (Luiselli et al. 1997, Martinez-Silvestre et al. 2001, Cadi et al. 2004, Pérez-Santigosa et al. 2008, Vamberger et al. 2012, Kleewein 2014a).

Graptemys pseudogeographica (Gray, 1831) is also a species native to North American but with smaller native range than *Trachemys* species (Ernst & Lovich 2009). In its native range it is present with two subspecies: *G. p. kohnii* (Baur, 1890) and *G. p. pseudogeographica* (Gray, 1831). As a pet animal it is now among the most traded turtle species, with annual export numbers very close to *Trachemys* sspp. (European Commission 2013, Kopecký et al. 2013). For this reason it is now also present in some countries of the Europe (Spain, Austria, Italy) (Egaña-Callejo 2007, Kleewein & Wöss 2009, Izquierdo et al. 2010, Kleewein & Wöss 2011, Kleewein 2014b, Ottonello et al. 2014).

Pelodiscus sinensis (Wiegmann, 1834) in contrast to the previous mentioned species is native to Asia. It is very attractive for its beautiful and soft shell so it has also been included in the pet trade and become present in the wild in some countries of Europe (Bosnia and Herzegovina – B&H, Croatia, Latvia, Slovenia) (Brejcha et al. 2013, Pupins & Pupina 2011).

Three species of aquatic turtles are registered in Croatia by the Checklist of Croatian amphibians and reptiles (Jelić 2014): *Emys orbicularis* (Linnaeus 1758), *Mauremys rivulata* (Valenciennes, 1833) and the allochthonous *T. scripta*. *Trachemys* is first recorded entering the Balkan peninsula some 40 years ago (Džukić & Kalezić 2004) and recently it was identified as a threat for the native pond turtle, *Emys orbicularis* (Linnaeus, 1758), Janev Hutinec et al. 2006, Brejcha et al. 2013) Lončar (2006). Šalomon et al. (2013) and Janev Hutinec & Kolačko (2013) also mention *T. scripta* in Maksimir park (Zagreb, Croatia) in terms of *E. orbicularis* conservation activities. In Croatia the presence of *Graptemys* species is known only since 2006 when one individual of *G. p.kohnii* was noted during *Trachemys* monitoring (Lončar 2006 - photographic

evidence). This individual has been removed and since then this subspecies has not been recorded again. From the literature only one locality per country is known for the presence of *P. sinensis*, in Croatia (Maksimir; five records for the same location) and B&H (Mostarsko blato; one record) (Brejcha et al. 2013).

Our goal was to determine presence of all allochthonous turtle species in Croatia and B&H and to assemble the data on their distribution. In this study we present all available data on distribution of *T. s. elegans*, *T. s. scripta*, *G. p. kohnii* and *P. sinensis* and first records of introduction and distribution of *G. p. pseudogeographica* in Croatia.

MATERIAL AND METHODS

In this paper we summarize all current distribution records collected from scientific publications, media resources on herpetofauna, different reports, our own field surveys, and colleagues with reliable knowledge. All data was plotted as a UTM (10 × 10 km) grid in WGS 1984 coordinate system as decimal degrees. Based on collected data the first distribution map of *T. scripta*, *G. pseudogeographica*, *P. sinensis* and their putative subspecies is given (Figure 1.). All unique *Trachemys sp.* locations (n=46) were attributed with data on the average distance to the nearest city with more than 10000 people. Measurements were made in ESRI ArcGis 9.3 based on Croatian administrative data (census from 2011). Distance was measured from the record location to the city centroid in kilometres (km). For our analysis we consider localities closer than 15 kilometres away from city centroid as urban areas and all localities further away as rural. This separation is purely holistic and is only made for easier interpretation of the data. Statistical analysis was carried out in software PAST 2.06.

RESULTS

In total, 100 records from 46 localities were analysed, 94 records (40 localities) from Croatia and six (in six localities) from B&H. In Croatia these localities covered 13 out of 20 counties and in B&H three out of 10 counties. In both countries localities are distributed in all three biogeographic regions (Continental, Alpine and Mediterranean). Only 18 % of the data originates from literature records and 82 % correspond to new observations. The most records were reported for *T. scripta* (86 records in 43 localities) (Table 1). *Graptemys* species are represented only with five records for five localities and *Pelodiscus sinensis* with nine records in six localities. Only *Trachemys* species were recorded with more than one individual per locality. The maximum number of individuals observed together is listed in Table 2 for each locality. The most sightings of all alien turtles (all mentioned species and subspecies) and the biggest population of *T. scripta* (>200 individuals) is reported from Zagreb city, Maksimir park, where five semi-artificial ponds (total area of 8,2 ha) were built from 1839-1911.

For *T. scripta* only in 16 % of the records were more than 10 individuals observed, with a maximum of 242 individuals in the 3rd pond in Maksimir park (Zagreb). In 28 % between two and 10 individuals were observed and in 56 % only one individual was observed. From 46 localities where *T. scripta* was recorded, 13 of them (28 %) were located in rural areas and 33 (72 %) in urban areas (< 15 km from nearest city with >10000 people). Exactly 50 % of these locations were located within 5 km from the nearest city. A log linear model, of the distance to the nearest city and number of

observed individuals per location, showed just weak negative correlation (r= -0,2718; p= 0,0589).

Table 1. Number of recorded *Trachemys scripta elegans* and *Trachemys scripta scripta* in Croatia and Bosnia and Herzegovina in period 1999-2014. TRe (Total Records). UTM (number of UTM 10×10 km square with confirmed presence). NMax (Maximum number of individuals observed together). Mean (Mean number observed in a same locality). Total (Total turtles observed). Counties: Zagreb City (1), Zagreb County (2), Krapina-Zagorje County (3), Varaždin County (4), Brod-Posavina County (5), Bjelovar-Bilogora County (6), Osijek-Baranja County (7), Primorje-Gorski Kotar County (8), Lika-Senj county (9), Zadar County (10), Šibenik-Knin County (11), Split-Dalmatia County (12), Dubrovnik-Neretva County (13), Sarajevo County-Canton (14), Hercegovina-Neretva County-Canton (15).

Tablica 1. Ukupni broj zabilježenih jedinki *Trachemys scripta elegans* i *Trachemys scripta scripta* u Hrvatskoj i Bosni i Hercegovini u periodu 1999-2014. TRe (Ukupno nalaza). UTM (broj UTM 10×10 km polja sa potvrđenim prisustvom). NMax (maksimalan broj jedinki zabilježen na lokaciji). Mean (prosječan broj jedinki zabilježen na lokaciji). Total (broj ukupno viđenih jedinki). Županije: Zagrebačka (1), Zagreb (2), Krapinsko-zagorska (3), Varaždinska (4), Brodsko-posavska (5), Bjelovarsko-bilogorska (6), Osiječko-baranjska (7), Primorsko-goranska (8), Ličko-senjska (9), Zadarska (10), Šibensko-kninska (11), Splitsko-dalmatinska (12), Dubrovačko-neretvanska (13), Kanton Sarajevo (14), Hercegovačko-neretvanski kanton (15).

	Croatia													Bosna and Herzegovina	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
TRe	44	3	2	1	1	2	1	20	1	1	3	2	1	3	1
UTM	4	2	2	1	1	2	1	7	1	1	2	2	1	3	1
NMax	242	1	21	2	2	2	1	2	1	2	38	6	1	30	1
Mean	20,5	1	11	2	2	1,5	1	1,2	1	2	16,3	3,5	1	13,7	1
Total	900	3	22	2	2	3	1	23	1	2	49	7	1	41	1

Table 2. Records of non-native turtle species in Croatia and Bosnia and Herzegovina during 1999-2014 (*T.s.* - *Trachemys scripta* (unknown subspecies), *T.s.s.* - *Trachemys scripta scripta*, *T.s.e* - *Trachemys scripta elegans*, *G.p.* - *Graptemys pseudogeographica* (unknown subspecies), *G.p.k.* - *Graptemys pseudogeographica kohnii*, *G.p.p.* - *Graptemys pseudogeographica pseudogeographica*, *G.* sp. - *Graptemys* (unknown species), *P.s.* – *Pelodiscus sinensis*). Unpublished sources: ADNAN ZIMIĆ - (1), ANA ŠTIH - (2), BERISLAV HORVATIĆ - (3), BILJANA JANEV-HUTINEC - (4), DINA HLAVATI - (5), EDUARD KLETEČKI - (6), EMINA ŠUNJE - (7), IGOR VILAJ - (8), IVAN BUDINSKI - (9), IVAN ŠPELIĆ - (10), IVO PERANIĆ - (11), KARMEN KARLUŠIĆ - (12), KREŠIMIR MIKULIĆ - (13), MARIO SCHWEIGER - (14), MARKO DOBOŠ - (15), MILA LONČAR - (16), MLADEN ZADRAVEC - (17), PATRIK KRSTINIĆ - (18), PETAR VLCEK - (19), SENKA BAŠKIERA - (20), SLAVKO STRUNA - (21) and STJEPAN MEKINIĆ - (22).

Tablica 2. Nalazi stranih vrsta kornjača u Hrvatskoj i Bosni i Hercegovini u razdoblju 1999-2014 (*T.s.* - *Trachemys scripta* (nepoznata podvrsta), *T.s.s.* - *Trachemys scripta scripta*, *T.s.e* - *Trachemys scripta elegans*, *G.p.* - *Graptemys pseudogeographica* (nepoznata podvrsta), *G.p.k.* - *Graptemys pseudogeographica kohnii*, *G.p.p.* - *Graptemys pseudogeographica pseudogeographica*, *G.* sp. - *Graptemys* (nepoznata podvrsta), *P.s.* – *Pelodiscus sinensis*). Neobjavljeni izvori: ADNAN ZIMIĆ - (1), ANA ŠTIH - (2), BERISLAV HORVATIĆ - (3), BILJANA JANEV-HUTINEC - (4), DINA HLAVATI - (5), EDUARD KLETEČKI - (6), EMINA ŠUNJE - (7), IGOR VILAJ - (8), IVAN BUDINSKI - (9), IVAN ŠPELIĆ - (10), IVO PERANIĆ - (11), KARMEN KARLUŠIĆ - (12), KREŠIMIR MIKULIĆ - (13), MARIO SCHWEIGER - (14), MARKO DOBOŠ - (15), MILA LONČAR - (16), MLADEN ZADRAVEC - (17), PATRIK KRSTINIĆ - (18), PETAR VLCEK - (19), SENKA BAŠKIERA - (20), SLAVKO STRUNA - (21) i STJEPAN MEKINIĆ - (22).

Locality	**Geographic coordinates**		**Species**	**Year**	**Notes and Pers.Com. (source)**	**UTM**
	Latitude, N	**Longitude, E**				
Lake in Bundek park (Zagreb)	45,785267°	15,984014°	*T.s.e.*	2014	28 specimens	WL77
Lake in Botanical garden (Zagreb)	45,804906°	15,971572°	*T.s.e.*	2014	14 specimens	WL77
			T.s.s.		7 specimens	WL77
Jarun lake (Zagreb)	45,776496°	15,927268°	*T.s.e.*	2014	13 specimens	WL76
			T.s.s.		6 specimens	
			G.p.p.		1 specimen	
Vrapčak stream (Španska- Oranice, Zagreb)	45,796790°	15,892369°	*T.s.e.*	2013	1specimen (2)	WL67
Vrapčak stream (Vukasova street)	45,891636°	16,098474°	*T.s.e.*	2010	4 specimens (17)	WL77
Kustošak stream (Trešnjevka, Zagreb)	45,794300°	15,931000°	*T.s.e.*	2012	1specimen (12)	WL77
First lake (Maksimir, Zagreb)	45.9521666°	16.2884999°	*P.s.*	2010	1 specimen (Brejcha et al. 2013)	WL77
			T.s.e.	2012	43 specimens (4)	
			T.s.s.	2013	3 specimens (15)	
Second lake (Maksimir, Zagreb)	45,824037°	16,021638°	*T.s.e.*	2012	23 specimens (4)	WL77
			T.s.s.	2013	6 specimens	
			G.p.p.	2013	1 specimen	
Third lake (Maksimir, Zagreb)	45,825266°	16,018595°	*P.s.*	2008	1 specimen (Brejcha et al.	WL77

					2013)	
			P.s.	2009	1 specimen (Brejcha et al. 2013)	WL77
			T.s.e.	2013	242 specimens	
			T.s.s.		10 specimens	
			G.p.p.		2 specimens	
Fourth lake (Maksimir, Zagreb)	45,830487°	16,027507°	*P.s.*	2009	1 specimen (Brejcha et al. 2013)	WL77
			T.s.e.	2013	10 specimens (4)	
			T.s.s.		1 specimen (15)	
Fifth lake (Maksimir, Zagreb)	45,831955°	16,025499°	*T.s.e.*	2012	20 specimens (4)	WL77
			T.s.s.	2013	1 specimen (15)	WL77
			G.p.k	2006	1 specimen (Lončar 2006)	WL77
Savica lakes (Zagreb)	45,772382°	16,026906°	*T.s.e.*	2014	30 specimens	WL76
Kraljevac stream (Zagreb)	45,858422°	15,949171°	*T.s.e.*	2009	1 specimen (13)	WL77
Sava River (Šćitarjevo)	45,778979°	16,138229°	*T.s.e.*	2011	1 specimen (11)	WL87
Kupčina River (Kostanjevec)	45,697759°	15,473853°	*T.s.e.*	2011	1 specimen (21)	WL36
Finzula Lake (Rakitje)	45,800076°	15,828618 °	*T.s.e.*	2012	1 specimen (10)	WL67
Nadolez Lake (Rakitje)	45,794060°	15,840038°	*T.s.e.*	2012	1 specimen (10)	WL67
Bedekovčanska Lakes (Hrvatsko Zagorje)	46,039522°	16,003593°	*T.s.e.*	2012	20 specimens (6)	WL79
On the road near Krapinjčica stream (Krapina)	46,140100°	15,880400°	*T.s.e.*	2013	1 specimen (2)	WM60
Trakošćan Lakes	46,260756°	15,937322°	*T.s.e.*	2013	2 specimens (8)	WM72
Sovsko lake (Dilj mountain)	45,287526°	18,014807°	*T.s.e.*	2009	2 specimens (16)	BR61
Pond Bara (Grubišno polje)	45,664821°	17,149793°	*T.s.e.*	1999	2 specimens	XL65
			P.s.		1 specimen	
Daruvar	45,599897°	17,226832°	*T.s.s.*	2014	1 specimen (20)	YL05
Našice, pond in city park	45,494686°	18,095112°	*T.s.e.*	2010	1 specimen (5)	BR74
Pond in city park on Sušak (Rijeka)	45,330546°	14,434855°	*T.s.*	2009	2 specimens (Š. D. 2009)	VL51
Pond on Pehlin (Rijeka)	45,323738°	14,490792°	*T.s.e.*	2014	1specimen (18)	VL61
Podugrinac, well near house (Vinodol)	45,152898°	14,769117°	*T.s.*	2014	1specimen (16)	VK89
Kimpi pond on Krk Island	45,034844°	14,558675°	*T.s.e.*	2007	2 specimens (3)	VK68
Mišušalnica pond on Krk Island	45,054678°	14,649828°	*T.s.e.*	2009	2 specimens (3)	VK78

Sv. Vid pond on Krk Island (Prniba)	45,015556°	14,621606°	*T.s.e.*	-	2 specimens (14)	VK78
Three ponds near Čižići on Krk Island	45,171103°	14,605842°	*T.s.e.*	-	Unknown (14)	VL60
Ponikve lake on Krk Island	45,080464°	14,555419°	*T.s.e.*	-	Unknown (14)	VK69
Jezero lake on Krk Island	45,167489°	14,559089°	*G.sp.*	-	Unknown (14)	VL60
Pag Island, Kolanjsko blato	44.558668	14.901563	*T.s.e.*	2007	1 specimen (Žagar et al. 2013)	VK93
Vir Island, pond on Dočina	44,294035°	15,076168°	*T.s.e.*	2002	2 specimens (6)	WK00
Šibenik, fountain in city park	43,734168°	15,894248°	*T.s.*	2010	10 specimens	WJ74
Rivina jaruga (Skradin)	43,815171°	15,925906°	*T.s.e.*	2013	1 specimen (9)	WJ75
Staro selo (Podgora)	43,250500°	17,089916°	*T.s.*	2006	1specimen (22)	XH69
Zbujača pond (Trogir)	43,525061°	16,239750°	*T.s.e.*	2011	6 specimens (22)	XJ01
Trsteno (Dalmacija)	42,715312°	17,977306°	*T.s.*	2007	1specimen (19)	YH43
Pionirska valey (Sarajevo, B&H)	43,878787°	18,413046°	*T.s.e.*	2012	30 specimens (7)	BP96
Vrelo Bosne (near Igman mountain, B&H)	43,810178°	18,287651°	*T.s.e.*	2012	5 specimens (1)	BP85
Hutovo blato (Mostar, B&H)	43,062424°	17,785313°	*T.s.e.*	2013	1 specimen (HINA, 2013)	YH27
Garden pond in national museum in Sarajevo (B&H)	43,855090°	18,402655°	*T.s.e.*	2010	6 specimens	BP95
Mostarsko blato (B&H)	43,384346°	17,653113°	*P.s.*	2010	2 specimens (Brejcha et al. 2013)	YJ10
Bardača (B&H)	45,101463°	17,424284°	*P.s.*	2010	1 specimen (Šikanjić 2010)	BR82

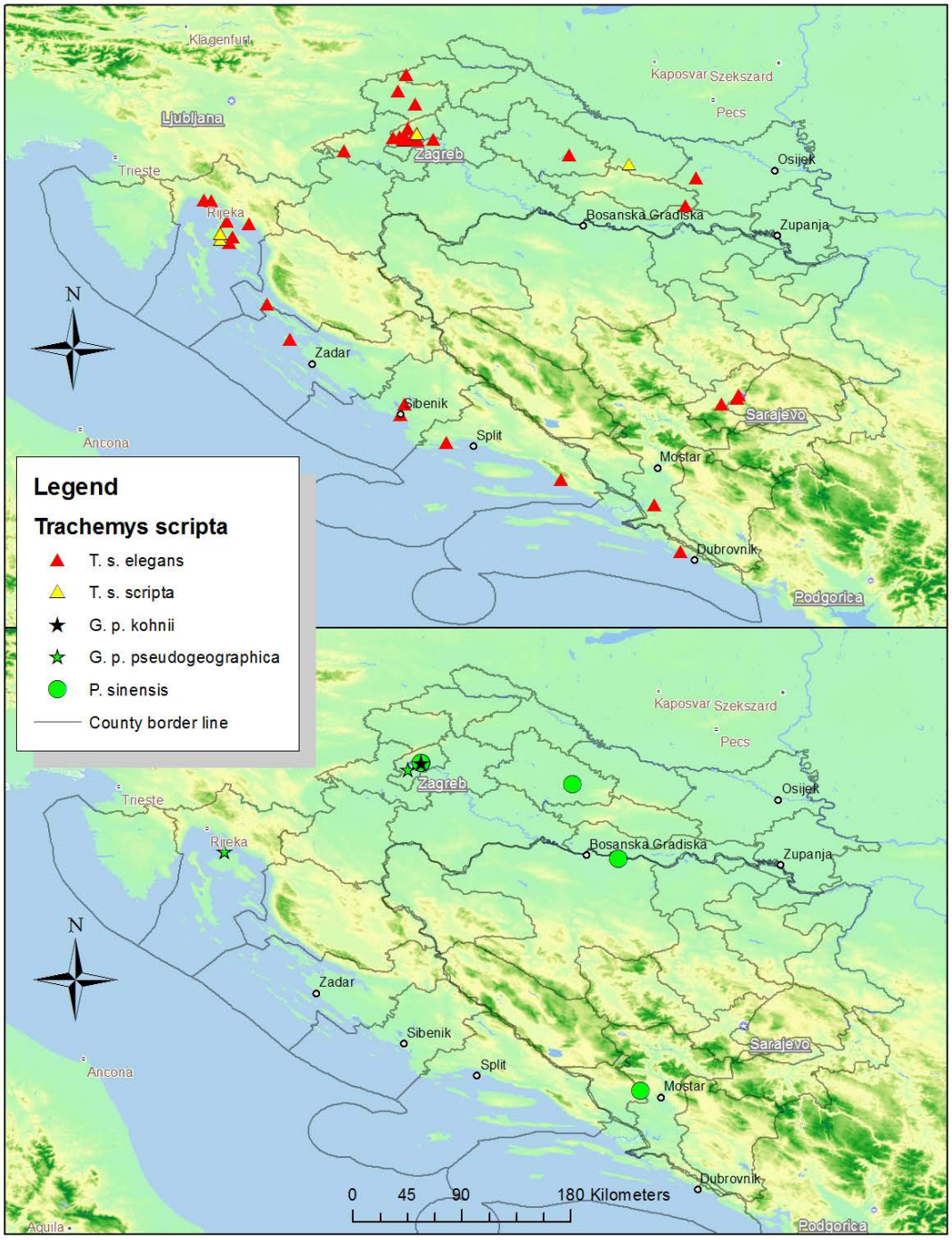

Figure 1. Distribution map with records of T. *s. elegans*, T. *s. scripta*, *G. p. pseudogeographica*, *G. p. kohnii* and *P. sinensis* in Croatia and B&H.

Slika 1. Karta rasprostranjenosti sa nalazima T. *s. elegans*, T. *s. scripta*, *G. p. pseudogeographica*, *G. p. kohnii* i *P. sinensis* Hrvatskoj i Bosni i Hercegovini.

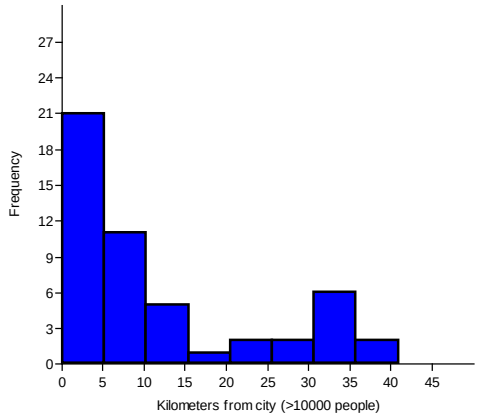

Figure 2. Average distance of the *Trachemys sp.* location of sighting (n=46) to the nearest city center (only cities with more than 10000 people were taken into account).

Slika 2. Prosječna udaljenost nalazišta *Trachemys sp.* (n=46) do najbližeg gradskog centra (samo gradovi sa više od 10000 stanovnika su uzeti u obzir).

DISCUSSION

From three registered introduced species only *T. scripta* could be considered invasive. Records of *G. pseudogeographica* and *P. sinensis* are still just minimal. It is obvious that most of the *Trachemys* data corresponds to single individual observations and even though all individuals were not observed, these localities can be considered as localities without an established population. Some of the observed populations with more than 10 individuals are showing indications of stability over years and mostly even an increase in individual numbers. Reports of *Trachemys* introduction and naturalisation are available from countries surrounding Croatia and B&H (Hungary, Italy, Slovenia, Serbia and Montenegro) (Puky et al. 2004, Ficetola et al. 2012, Lazarević et al. 2012, Žagar et al. 2013). From our data it is now justified to claim that *Trachemys* has become naturalised in Croatia, especially in the city of Zagreb and its wider area. This is the direct result of the most intensive introduction of individuals, from pet trade, in this specific area (inhabited by around ¼ of Croatia's total population). In B&H still only individual records are available, but this could be the result of insufficient research. Although the occurrence of reproduction of *Trachemys* is known from some surrounding countries (Italy and Slovenia) (Luiselli et al. 1997, Vamberger et al. 2012), we still suspect that Croatian and B&H populations are mostly the consequence of individual pet owner's releases. We assume that natural reproduction, if present, is probably very rare and egg and juvenile mortality is very high. Some juveniles manage to hatch and possibly survive to adulthood, but their numbers cannot be enough to maintain the population. The same was also indicated by Luiselli et al. 1997 for the Central Italian populations of *T. scripta*. We consider that our populations are primarily maintained and increased by constant anthropogenic input of new individuals from the pet trade.

T. scripta occurs continuously over the whole region with most sightings in and close to urban areas (Figure 2.). This suggest a negative correlation between turtle density and distance from cities (as sources of introduction), but positive correlation between turtle density and concentration of human settlements. This is similar to data from other countries in their non native range (Arvy & Servan 1996).

Few localities (Bundek lake, Jarun lakes, Savica lakes and Maksimir park) all in the urban area City of Zagreb, deserve our special attention in term of management actions because of the number of individuals and closeness or connection to a main river system (Sava River). All these localities are positioned upstream of nature protected areas Žutica, Turopolje and Lonjsko polje Nature Park,

where large populations of *E. orbicularis* are present (Jelić et al. 2012). It is without question that these urban ponds act as invasion source and that animals can drift down into the natural habitats. Their fate there is unknown. These natural areas are usually very large and inaccessible for research therefore enabling the turtles to remain undetected. Bringsøe (2001) in term of successful invasion mentions that only small areas of southern Europe would have a suitable climate for slider turtles and Luiselli et al. (1997) suggested a limited reproductive capability and a very low survival of juveniles, some authors however are predicting a possible increase in invasiveness due to recent climate change (Ficetola et al. 2008, Kikillus et al. 2010). Therefore this topic in our territory requires additional research based on up to date distribution data and predictive ecological models.

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