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FIRST RECORDS OF NEW AQUATIC PREDATOR *PELODISCUS SINENSIS* (WIEGMANN 1835) IN LATVIA AND PRELIMINARY ECOLOGICAL RISK ASSESSMENT OF THE INVASION FOR AUTOCHTHONIC *EMYS ORBICULARIS* (LINNAEUS 1758)

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The research on occurrence of exotic and invasive turtles in Latvia was conducted as a part of the research on *Emys orbicularis* distribution and ecology in Latvia. Up to 2011 six exotic species and subspecies of turtles were recorded in Latvia, including invasive Far-East species *Pelodiscus sinensis*. In the research we registered *P.sinensis* in 2008 (#PeSi0001) and in 2010 (#PeSi0002) in central part of Latvia, and we found one big adult specimen (#PeSi0003) in South-East part of Latvia in 2014. The specimen and the habitats of the findings were investigated in a comparison. Capacity for naturalization and colonization, and possible influence of *P.sinensis* to autochthonic European pond turtle *E.orbicularis* was analysed and discussed for Latvia.

Key words: Testudines, *Pelodiscus sinensis*, Chinese softshell turtle, invasive species, distribution range, *Emys orbicularis*, ecological risk, nature conservation, Latvia.

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INTRODUCTION

Only one autochthonous species of turtles inhabits Latvia - European pond turtle *Emys orbicularis* Linnaeus 1758 (Siliņš, Lamsters 1934, Caune 1992). It is a rare (Bērziņš 2003). protected species (Ministru kabinets 2000, Pupiņš, Pupiņa 2007, 2014.) inhabiting here on the extreme northern border of its area of distribution in Europe (Fritz 2003, Meeske et al. 2006, Pupins, Pupina 2008a,b).

Due to the development of international economic relationships, migration of the Latvian population, travel industry, and pet trade exotic species of turtles are imported to Latvia, and they can get into natural environment for a number of reasons. It is known that *Trachemys scripta elegans* imported to Europe have successfully established in many European countries, started to breed in the wild, and they are invasive strong competitors of the autochthonous species *Emys orbicularis* (Cadi, Joly 2003, 2004).

Over the last years due to active import of pets, their illegal introduction to natural environment and escape from their owners an exotic species of turtles *Trachemys scripta elegans* has been repeatedly reported in Latvia. The first group consisting of 6 adults was recorded in 2007 near Nitaure (Pupins 2007).

Up to 2011 six exotic species and subspecies of turtles were recorded in Latvia. Most of them were single adults. In the research *Pelodiscus sinensis* was recorded in Latvia in 2008 for the first time (Pupins, Pupina 2011).

Invasive species of turtles, e.g. a Far-Eastern *Pelodiscus sinensis,* spread themselves in new regions, also in European countries, due to human introduction (Welcomme & Vidthayanom 2003, Sy et al. 2004). It is important to understand whether some of the exotic turtles imported and introduced to Latvian natural environment (Pupins & Pupina 2011) can establish in Latvia, occupy new ecological niches and influence local flora and fauna, especially rare autochthonic *E.orbicularis* (Meeske & Pupins 2009).

Therefore research on occurrence of exotic turtles in Latvia and elimination of the non-indigenous species from natural environment are recommended measures of the official "European Pond Turtle *Emys orbicularis* Linnaeus 1758 Conservation Plan in Latvia" (Pupiņš & Pupiņa 2007). All these factors make the research on situation of exotic species *Pelodiscus sinensis* in Latvia essential.

MATERIAL AND METHODS

The research on occurrence of exotic and invasive turtles in Latvia was conducted as a part of the research on European pond turtle *Emys orbicularis* distribution and ecology in Latvia. As record of exotic turtles in wild was complicated because of small number of the turtles in Latvia, interview of Latvian residents was used as a primary method of research. At the same time a mass campaign among the Latvians was launched warning that exotic turtles could be found in the wild; people were supposed to report about the exotic turtles found, etc. The following population groups were interviewed intentionally: 1) people, whose jobs are connected with nature conservancy (environment protectors, woodwards, fishing inspectors); 2) residents of Latvia, who use natural resources on a regular basis (fishermen, hunters, mushroom gatherers, farmers, forest industry workers); 3) people, who are interested in the information on Latvian nature (newspaper, magazine readers, TV watchers); 4) people, who aspire to get in touch with nature (zoo visitors, tourists); 5) people connected with keeping turtles as pets (terrariumists, shop-assistants in pet shops); 6) residents of the areas where the presence of turtles was observed.

After information about any turtle observed in Latvia had been received, a respondent was interviewed in private or by telephone for 10-30 minutes. During the interview additional questions were asked to prove the plausibility of the report, additional ecological data on the discovery was obtained. Those reports were registered, which allowed to make an accurate identification of the described case: having exact description of a species characteristics, a photo or an animal itself caught and delivered to the authors.

Species identification for caught turtle was carried out visually with the help of corresponding guides (Terentyev & Chernov 1949, Bannikov et al. 1977). The authors also drew on their practical experience in working with exotic species of turtles, consulting international specialists from species natural area of distribution when it was necessary.

Mapping of locations where exotic turtles were found was made with the help of the *GPS eXplorist 100 Magellan.* The programs *Google Earth* and *SAS Planet* were used as well.

The waterbodies of findings were mapped and the habitats were inspected. Location, size, type, character, connection with other water bodies, corridors, overgrowing, open shelf, anthropogenic influence and other characteristics

of reservoirs were investigated in accordance with the standard methods. The data on habitats of reservoirs, their condition, size, overgrowing and anthropogenic influence on biotopes were received in field expeditions to places of findings. Current, overgrowing of bank zone, pollution were visually estimated according maximal possible value (no – 0; yes – 1; or from 0 till 10). Location of small reservoirs was defined with a *GPS Magellan Explorist*, large reservoirs and rivers – with orthophotograph, *SAS* and *Google Earth* service. Measurement of linear parameters of biotopes (dimensions of a pond, shore legislation, distance to other ponds, etc.) was carried out with the help of the *Google Earth* and *SAS Planet* measuring service.

RESULTS

Three records of *Pelodiscus sinensis* in Latvia. In the research we registered *Pelodiscus sinensis* in 2008 (#PeSi0001) and in 2010 (#PeSi0002) in central part of Latvia, and we found one big adult specimen (#PeSi0003) in South-East part of Latvia in 2014 (Fig. 1).

Record # PeSi0001

Specimen. First recorded in 2008 in Olaine animal (# PeSi0001) was identified as a *Pelodiscus sinensis* (Pupins et al. 2009) (Fig.2, 3, 4). The *P.sinensis* was young adult male, the length of its carapace was 135 mm, and width of the carapace was 114 mm. The animal did not have any external injuries, but was low-fed. The person, which found the animal, before the sending the animal to the authors fed him with *Bufo bufo* tadpoles, that are toxic for most reptile predators, possible therefore the specimen was passive and dead in next day after receiving.

Fig. 2. First *P.sinensis* #PeSi0001 found in Latvia: head, legs and tail of the male are visible.

Fig.1. Placement of the findings of *Pelodiscus sinensis* in Latvia.

Habitat. *Pelodiscus sinensis* was caught by a net while fishing in an *Castor fiber* created small anonymous lake (Fig. 5); that had appeared when the melioration system canals got flooded near the place of their connection with the river Misa. The maximal length of the lake is 121 m. The coast line is 361 m, the banks are poorly structured. The maximal depth of the lake is 2-3 m, the bottom is slimy. Such fish species as *Carassius carassius*, *Tinca tinca*, *Esox lucius* are found in the lake which is used for recreation and fishing (Pupins, Pupina 2011).

Record # PeSi0002

Specimen. In the second case (# PeSi0002), the respondent, an experienced teacher of biology, watched a juvenile turtle in the lake Racenu (Madonas novads, Lazdonas pagasts), near the bank; according to the description (it was described as a swimming light-coloured turtle not more than 10 cm in length with a carapace devoid of individual scutes), from all found in Latvia six exotic turtles species it possible have been a case of *Pelodiscus sinensis*.

Habitat. The Racenu lake is 931 m long and 717 m wide; its coast line is 3,716 m; the banks grown with forest and bushes (Fig 6). Average depth is 4.6 m, maximal – 10.7 m (Ezeri.lv 2015). The lake is rich with fish and is used for recreation. Such fish species as *Perca fluviatilis*, *Rutilus rutilus*, *Tinca tinca*, *Esox lucius*, *Scardinius erythrophthalmus*, *Abramis brama* are living in the lake which is popular for recreation and fishing.

Fig. 3. Dark dorsal side of the first *P.sinensis* #PeSi0001 found in Latvia.

Fig. 4. Ventral side of the first *P.sinensis* #PeSi0001 found in Latvia.

Fig. 5. Olaines lake, habitat of the first *P.sinensis* #PeSi0001 recorded in Latvia (Photo: Drezina, 2008).

Fig. 6. Racenu lake bank zone, habitat of second, juvenile *P.sinensis* #PeSi0002 recorded in Latvia.

Table 1. Full list of the records of *P.sinensis* in Latvia

Records	Registration number	Location	Year of recording	Coordinates	Number of specimen
First record***	PeSi0001*	Rigas novads, Olaine	2008	56°46'9.66"N; 23°55'56.89"E	1 adult male
Second record***	PeSi0002**	Madonas novads, Racenu lake	2010	56°49'54.88"N; 26°13'16.28"E	1 juvenile
Third record	PeSi0003	Daugavpils, Esplanades Kiru pond	2014	55°52'29.83"N; 26°30'36.25"E	1 big adult male

* data concerning this finding for the first time were presented at the conference in University of Latvia in 2009 and published in the conference abstracts,
** the species was determined following the description of the respondent.
*** the data on the two records were published in 2011 (Pupins, Pupina 2011).

Record # PeSi0003

Specimen. On August 28, 2014 we got new *Pelodiscus sinensis* found in Latvia. It was found in south-eastern Latvia, on the outskirts of Daugavpils dwelling zone, near to asphalt road Vienibas street. It was a large adult male *Pelodiscus sinensis*, the length of its carapace was 224 mm. The animal did not have any external injuries, was well-fed. When being placed in the terrarium the animal was agile and expressed fear of people, which can indicate that it had been in the wild for quite a long period of time. The authors' long-term observations show that *Pelodiscus sinensis* kept in zooculture are usually very brave and active, they aspire to contact with the people feeding. The *Pelodiscus sinensis* refused to eat and died in 4 days. It may have been injured by a vehicle while crossing the road or by the resident who caught it.

Habitat. Third *Pelodiscus sinensis* (# PeSi0003) was found 100 m away from the Daugava River, off the road near an eutrophic and swampy Esplanades Kiru pond, which was formed as a result of clogging of reclamation canals. In the north-west the pond joins Daugavpils disposal works, from which it is separated by a sand fill 2-3 m high. The pond is connected with the Sunica River by means of canals. Maximum pond length makes 320 m, maximum width – 220 m. The water-front length is 1000 m, the shores are weakly structured. The distance to the nearest house is 110 m, to the nearest asphalt road – 86 m, to the Daugava River – 200 m. Maximum depth of the pond is 2 m, the bottom is miry and turfy. The bottom and surface of the pond abound in water plants. When the turtle was caught the open area of the water surface made no more than 15%. *Carassius carassius*, *Perccottus glenii* and a large number of invertebrates were found in the pond. A number of *Pelophylax lessonae* inhabit the pond, a young *Natrix natrix* was observed on-shore. A large breeding colony of *Chroicocephalus ridibundus* inhabits the pond. In summer it is used for fishing, residents walk their dogs on the north-west shore.

As a result of the research three findings of *Pelodiscus sinensis* are known in 2014 in Latvia (Table 1).

Comparative investigation of the habitats

The water habitats of all three findings (Fig. 7, 8, 9) were investigated in detail according 16 parameters (Table 2).

The peculiarities of *P.sinensis* findings waterbodies in Latvia were visually compared and the average was found for all the parameters showed in the Radar charts (Fig. 10, 11, 12).

***Pelodiscus sinensis* and *Emys orbicularis* in Latvia**

The *P.sinensis* in all cases were found not more than 30 km from known higher plausibility (found

Table 2. Comparative investigation of the habitats of finding of *P.sinensis* in Latvia

Parameters of habitats	**PeSi0001**	**PeSi0002**	**PeSi0003**	***Average***
Waterbody length (m)	121	931	330	460
Waterbody width (m)	64	717	250	341
Waterbody depth max (m)	3	9	2	4,6
Waterbody shelf depth average (m)	1	2	1	1,3
Coastline length (m)	361	3716	925	1667
Current (0/0,5/1)	0,5	0	0	0,16
Connection with river (0/1)	1	0,5	0	0,5
Connection with channel (0/x)	2	1	1	1,3
Distance to lake (m)	5000	800	2000	2600
Distance to nearest river (m)	30	1470	365	622
Distance to nearest road (m)	224	410	21	218
Distance to nearest building (m)	240	426	53	240
Overgrowing (0-10)	2	1	10	4,3
Urbanization (0-10)	2	1	3	2
Pollution (0-10)	2	1	7	3

Fig. 7. Orthophoto of habitat of findings of *P.sinensis* #PeSi0001 in Olaine, Latvia (*Google Earth* services).

by authors or described by photo) findings of *E.orbicularis* in Latvia.

The *P.sinensis* #PeSi0001 was found in a distance of 18 km to the *Emys orbicularis* finding #EmOr0028 (all the numbers according to authors *Emys orbicularis* data base for Latvia) in Jelgava city, where other findings are known also.

The *P.sinensis* #PeSi0002 was registered in a distance of 30 km to the *Emys orbicularis* finding #EmOr0015 in 2003 (Madonas novads, Jumurdas pagasts). Found old adult female *Emys*

Fig.8. Orthophoto of habitat of findings of *P.sinensis* #PeSi0002 in Madonas novads, Latvia (*Google Earth* services).

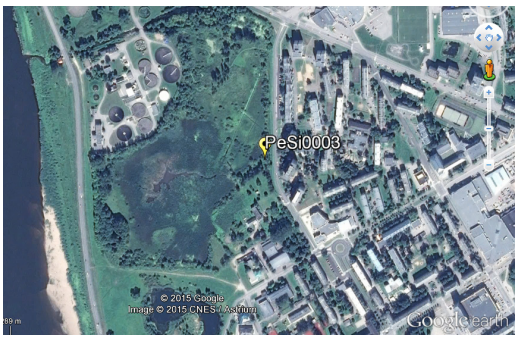

Fig. 9. Orthophoto of habitat of findings of *P.sinensis* #PeSi0003 in Daugavpils, Latvia (*Google Earth* services).

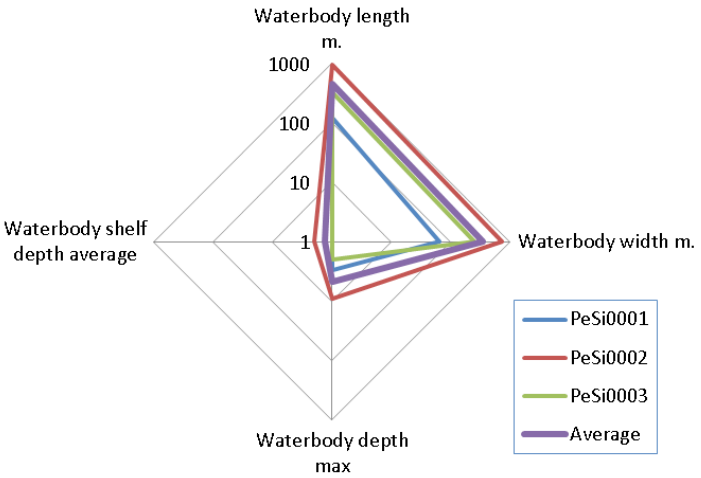

Fig. 10. Peculiarities of *P.sinensis* findings waterbodies size in Latvia.

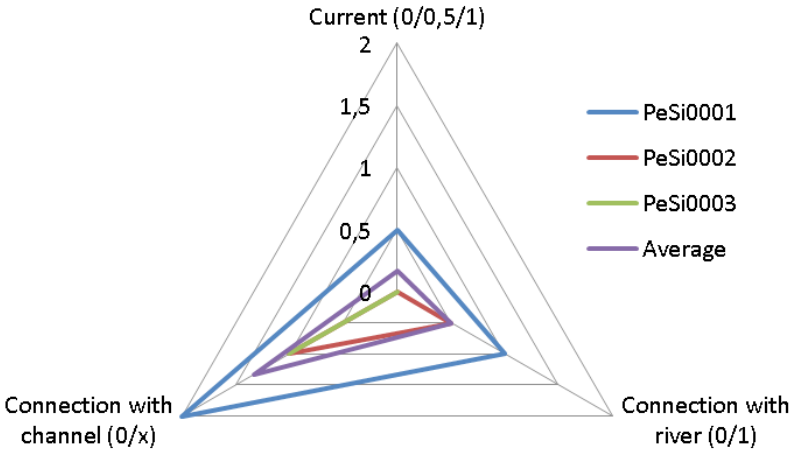

Fig.11. Peculiarities of *P.sinensis* findings waterbodies water connectivity in Latvia.

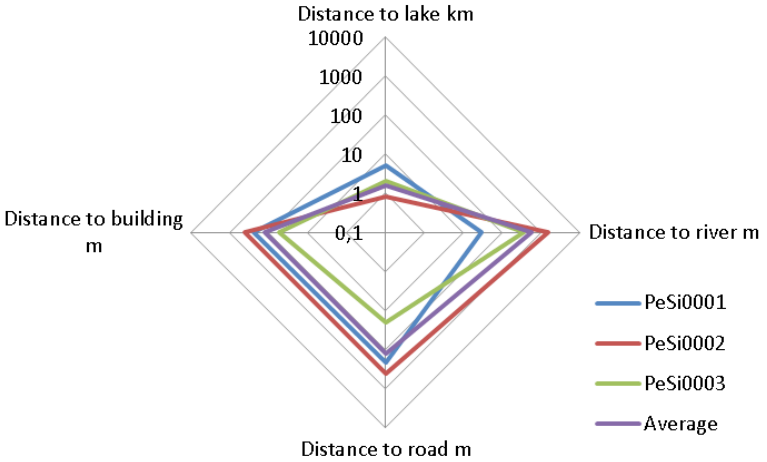

Fig.12. Peculiarities of *P.sinensis* findings waterbodies anthropogenic influence and distance potential for species distribution in Latvia.

Fig.13. Old adult female of *Emys orbicularis* from the habitat, where *Pelodiscus sinensis* #PeSi0003 was found in 2014 (Daugavpils, Latvia) (Photo: 2003).

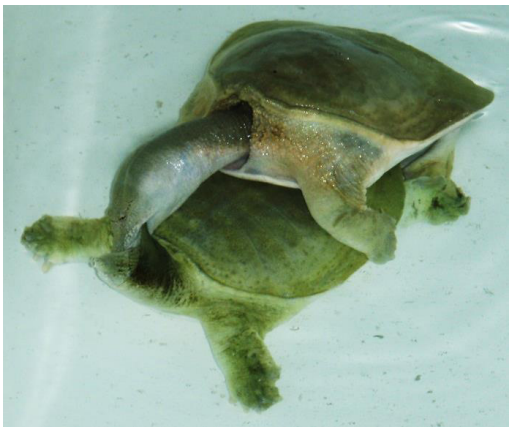

Fig. 14. Received from owners *P.sinensis* breeding in captivity (Latgales Zoo, shelter for exotic turtles).

Fig. 15. *P.sinensis* laid eggs after breeding in captivity (Latgales Zoo, shelter for exotic turtles).

orbicularis with carapace length 196 mm that was looking for eggs-laying place near to fish ponds and laid 7 eggs the next day after catching.

The *P.sinensis* #PeSi0003 was found in 2014 in the habitat of historical finding #EmOr0001 of *Emys orbicularis* in 1984 in Latvia, Daugavpils. The found *Emys orbicularis* was an old adult female with carapace length on 210 mm, which laid 12 eggs in two days after catching and was kept for 24 years in a breeding group of Latgales Zoo till its death in 2008 (Fig.13). Three more verified *Emys orbicularis* findings in Daugavpils novads in a distance not more than 10 km are known also.

Illegal trade vectors, vitality, possibility to be released in wild

Found vectors of distribution. In a result of the research and interviewing of pet shops and private sellers we found that approximately 300 – 500 young *Pelodiscus sinensis* were imported into Latvia in Soviet time in 1985 - 1990th years from Russian Far-East native populations and, possible, from zooculture farms in Vietnam. The trading was illegal because the *Pelodiscus sinensis* was preserved species in Soviet Union. Three big adult *Pelodiscus sinensis* (2 males, 1 female) were imported from Russia (bought in Moscow Bird Trade) in the same time period. One young *Pelodiscus sinensis* was sold in Daugavpils in a pet shop in 2002.

Estimated vitality. The imported animals are kept successfully in Latvia. Latgales Zoo has received four not wanted adult *Pelodiscus sinensis* (2 males, 2 females) from their owners in 2000 – 2004 for turtle shelter. One additional big male was received through Rigas Zoo in 2014. All the imported in Latvia and received from owners adult animals were in a good condition, bred actively (Fig. 14) and laid eggs in captivity in the same year (Fig. 15) in Latgales Zoo.

Releasing in wild. It is possible, that the not wanted Pelodiscus *sinensis* by their owners are released in wild in Latvia, because we know about releasing unnecessary water turtles in wild: six cases of adult *Trachemys scripta* and one case of allochthonous adult *Emys orbicularis*.

DISCUSSION

Condition. The third *P.sinensis* found in Latvia was a big adult, its body sizes are close to the ones described in Russia, with the average carapace length of an adult amounting in 250-330 mm (Terentyev, Chernov 1949, Bannikov et al. 1977). At the same time N.M.Przevalskiy (cited in: Kuzmin 2002) reported the record of a turtle weighing 6 kg with carapace length of 40 sm. This *P.sinensis* caught in Latvia has the same colour as the one described for the given species inhabiting the north of the area: its back is greenish-grey with small dark spots (Terentyev, Chernov 1949).

Expansion to the north. Assessing the possibility for the introduced *P.sinensis* to adapt to northern environmental conditions of Latvia it is necessary to mention that the given species inhabits a vast area and is spread quite far to the north. Its natural area includes Korea, China (Liaoning, Shaanxi, Anhui, Zhejiang), Manchuria, North Vietnam, Japan, Timor, South of Russian Far East (Kuzmin 2002, Uetz 2007). Thus, the northern edge of the species area in the 19th century was at 49^{o} N (Kuzmin 2002). However, according to the research carried out by V.Tagirova (1981; 1989, 1997, cited in: Kuzmin 2002), at present *P.sinensis* forms populations in Russia up to the city Komsomolsk-na-Amure (50^{o}33' N; 137^{o}3' E), and in summer the species extends further to the north (Tagirova, Yatsenko 2008). Some *P.sinensis* were found near the river Zeja: 51^{o}44' N; 128^{o}54' E. There are also records of *P.sinensis* in the northern and continental parts of Kirgizia, in the valley of the river Chu (Ananjeva et al. 1998, cited in: Kuzmin 2002). All this indicates that *P.sinensis* is able to spread far enough to the north, although its findings in Latvia are the northernmost known to the author.

Capacity for naturalization and colonization. Latvia is a too northern country in comparison with the natural distribution of *P.sinensis*. Nevertheless, it is necessary to mention that the species has a capacity for naturalization and colonization in a positive environment in many countries. Thus, after accidental and purpose introduction of *Pelodiscus sinensis* it has naturalized in a range of countries of the world: in Malaysia, Singapore, Timor, Thailand (introduced since 1977.g. (Welcomme, Vidthayanom 2003)), Batan Islands and in USA in California (Kuzmin 2002; Lever 2003; Asian Turtle Trade Working Group 2000; 2008), Oahu, Hawaii Islands (Englund, Arakaki 2004), Japan Ryu Kyu Islands (Lever 2003), Filippine (Sy et al. 2004), and, possibly Brazil (The Reptile Database). There is a problem of *Pelodiscus sinensis* colonization, as they escape, survive and can form populations (Sy et al. 2004). Thus,

the population in Singapore was formed by the animals that had escaped from the local turtle farms (Yong 1990).

Pelodiscus sinensis has naturalized in Europe as well: in Spain (Lever 2003), it has been recorded in Iberia (Pleguezuelos 2002, cited in: Garcıa-Berthou et al. 2007), Guadalkuivir (Lever 2003), in Bosnia, Herzegovina, Croatia (Jelic L, Jelic D. 2015), Slovenia (The Reptile Database), Balkans (Brejcha et al. 2014), France, Great Britain, and Madagascar (Kraus 2009, cited in Somma 2015).

Habitats. The third recorded animal recorded in the research must have occupied a favourable habitat in Latvia, as it inhabits similar biotopes in its natural area. In Russia *Pelodiscus sinensis* inhabits lakes, rivers with low flow, other clear freshwater bodies (Terentyev, Chernov 1949; Kuzmin 2002). Moreover, it is known that *Pelodiscus sinensis* inhabits swamps and rice fields (Baker 2003), its presence is possible in fish ponds (Tagirova, Yatsenko 2008) what is *Emys orbicularis* favourable habitat in Latvia.

Capacity for migration and relocation. In summer *Pelodiscus sinensis* in Russia moves to the north (Tagirova, Yatsenko 2008). Our observations in zooculture also show that it is a very active and mobile species. At the same time, in natural environment, being on shore, the animals do not usually move away from water farther than 1,5-2 m. When it is hot, they can burrow in the sand (Cherepanov 1990, cited in: Kuzmin 2002). That is why it is possible to assume that in Latvia *Pelodiscus sinensis* can move through a rich net of water bodies, especially in South-East Latvia. The pond, where the third specimen was found, is connected with the river Sunica and with Daugava through it.

Temperature requirements. Latvian climate is moderately cold. At the same time it is known that *Pelodiscus sinensis* usually inhabits areas with the temperatures 20-25°C and also relatively cold mountain rivers in Russia. Due to high level of metabolism its body temperature is usually higher than environmental temperature. *P.sinensis* can be exposed to high temperatures up to 42,3°C (Hozatsky, cited in: Kuzmin 2002). On the northern border of *P.sinensis* area in Russia the isotherm in January is -13°C, in August it is +21°C, frost-free season lasts for 150-155 days (Knystautas, Sibnev 1987, cited in: Kirschey 2000). In Daugavpils (Latvia) *P.sinensis* was recorded in the area with the highest average July temperature of +17°C and average frost-free season duration of 130-140 days (Turlajs (ed.) 2007). The small overgrown pond, where the third *Pelodiscus sinensis* was found, is well-heated in summer; therefore microbiotopes temperature can be more optimal for the species.

Diet. Within its natural area *P.sinensis* usually feeds in water (Emelianov 1944, cited in: Kuzmin 2002): it consumes fish, scallops, shellfish, worms and other aquatic animals available (Terentyev, Chernov 1949; Bannikov et al. 1977; Thomson 2008), as well as helas seeds (Baker 2003). Its food is diverse. For example, in Okinawa, Japan *P.sinensis* consumes representatives of 49 species out of 33 genuses and 21 orders (Sato et al. 2005). Males' feed composition in spring and summer is very diverse and includes land insects, fish, and frogs; in autumn their diet consists mostly of Mollusca. Females eat Mollusca all year round (Sato et al. 2005). It is obvious that *P.sinensis* can find necessary food supply in Latvia, as it was found near an eutrophic pond inhabited by fish, frogs, insect etc. and with rich vegetation.

Reproductive ecology, development and structure of populations. To assess the possibility for the introduced *Pelodiscus sinensis* to breed under the conditions of relatively cold Latvian climate it is important to mention that in Russia, which is located in the north of the species' range of distribution, it oviposits in June – July (Emelianov 1944; Anajeva et al. 1998: cited in: Kuzmin 2002), 2-3 times a season. There are usually 18 – 44 eggs (33 on average), the total number of eggs can reach 160 (Terentyev, Chernov 1949). In warmer countries, e.g. in Japan, *Pelodiscus sinensis* oviposits up to 4 times a year (Baker 2003). In the same time *Emys orbicularis* lays 5-18 eggs (Andreas, Paul 1998; Mitrus, Zemanek 1998; Schneeweiss et al. 1998). Egg-laying areas of *Pelodiscus sinensis* are usually covered by

plants, they are located in 10 – 35 m from the pond, maximal distance recorded was 154 m from water (Cherepanov 1990, cited in: Kuzmin 2002) – similar habitats are placed near to all findings in Latvia. Incubation lasts for 30-50 days (Knystautas, Sibnev 1987, cited in: Kirschey 2000), incubation at a temperature of 29°C lasts for 45-60 days, young turtles hatch in the middle of August (Emelianov 1944, cited in: Kuzmin 2002; Baker 2003). Average incubation period for *Emys orbicularis* in natural environment is much longer 70 – 110 days (Terentyev, Chernov 1949). Temperature fluctuation within the range of 28 – 30°C is more favourable for *P.sinensis* hatching than low (24°C) or high (34°C) temperatures (Xiang et al. 2003), as well as for the *Emys orbicularis*.

In natural environment in the north of Russia area *Pelodiscus sinensis* becomes fertile at the age 6-7 years (Terentyev, Chernov 1949), its carapace is 180-190 mm long (Tagirova 1997, cited in: Kuzmin 2002), juveniles make up the most of a population. Thus, 83 animals out of the 113 recorded in Russia were juveniles younger than 1 year old (Adnagulov 2008). The European pond turtle in the north of the Lithuanian area becomes fertile much later (Meeske 2006).

Hibernation. In the north of the area *Pelodiscus sinensis* hibernates on the bottom, in ooze (Tagirova 1997, cited in: Kuzmin 2002), it comes out of hibernation in April – May, when the water temperature rises up to 16°C (Emelianov 1944; Anajeva et al. 1998: cited in: Kuzmin 2002). It is probable that *Pelodiscus sinensis* can hibernate in Latvian climatic conditions, as the local species *Emys orbicularis* hibernates under ice in similar conditions. But it comes out of hibernation at the end of April – in the beginning of May, when the water temperature is only 5-10° C. A sun-basking *Emys orbicularis* has been noticed under ice (Seebacher 2006), we have not any information on this type of sun-basking in *Pelodiscus sinensis*.

Probable predators in Latvia. Up to 76,9% - 100% of eggs laid by *Pelodiscus sinensis* are destroyed by predators (Tagirova 1997, cited in: Kuzmin 2002). In the natural area the eggs are eaten by: *Vulpes vulpes*, *Nyctereutis procionoides*, *Corvus* sp., *Sus scrofa*. Young turtles are consumed by aquatic birds, as well as by *Vulpes vulpes*, *Nyctereutis procionoides*, *Corvus* sp., birds of prey, etc. (Cherepanov 1990, Tagirova 1997, 1981, cited in: Kuzmin 2002). All these predators inhabit Latvia. The invasive *Nyctereutis procionoides* is widely spread in Latvia and is considered an effective natural predator for *Pelodiscus sinensis.* Thus native and invasive predators of Latvian ecosystems are ready for *P.sinensis* invasion in wild as a new diet subject.

Parasites. Parasites of *Pelodiscus sinensis* recorded in Russia: *Cotylaspis parasinensis*, *Coeuritrema oschmarini*, *Leurosoma moemsis*, *Phyllodistomum* sp., *Cephalogonimus emydalis*, *Astiotrema reniferum*, *Astiotrema oldneri*, *Neopolystoma palpebrae*, *Spiroxys transversalata* (Strelkov 1950, cited in: Platt 2000; Sharpilo 1976, cited in: Kuzmin 2002). In Thailand representatives of *Vibrio* were observed in 83 out of 100 (83%) cloaca analyses taken from *Pelodiscus sinensis* kept in zooculture. Those were *Vibrio fluvialis* (26,04%), *V.anguillarum* (21,23%), *V.furnissii* (18,49%), *V.parahaemolyticus* (18,49%), *Vibrio* spp. (6,85%), *V.damsela* (5,48%), *V. metschnikovii* (3,42%) (Channarong et al. 2001). In 1999 China put import of *P.sinensis* under control due to *Salmonella* infection of farm-raised turtles (Dharmananda 2005). Leeches *Glossiphonia* attack *P. sinensis* in Russia (Emelianov 1944, cited in: Kuzmin 2002). Thus, *P.sinensis* imported and released in Latvia can become sources of parasitic diseases for autochthonic *Emys orbicularis* and for other species.

Aggressiveness. *P.sinensis* is often aggressive with humans, it bites, and there are reports of attacks on people in water (bites on stomach, chest) (Emelianov 1944, cited in: Kuzmin 2002). For commercial treatment of the animals it is suggested to use anaesthetics (Park et al. 2006).

Protection, zooculture and trade. The species is included in the IUCN list of endangered animals (Baker 2003), but only natural populations are protected (Asian Turtle Trade Working Group

2008). China has excluded *P.sinensis* from III Apendix CITES (Thomson 2008). The animals are actively used in Far-Eastern Asia as food, pets, in orthodox medicine and for religious purposes (Shepherd, Nijman 2008; Webb et al. 2008). Its wide use by people promotes mass breeding and fast expansion. In Kuala Lumpur one *Pelodiscus sinensis* costs 16 USD (40 USD/kg), which is twice more than *Trachemys scripta* (Webb et al. 2008). The species has been raised on farms in Japan since the 19th century (Webb et al. 2008). Mr. Hattori is likely to have been the first to breed *P.sinensis* in zooculture in 1866 not far from Tokio. He produced 82 000 eggs in 1904 and sold 60 000 adult turtles in 1907 (Dharmananda 2005). The species is also actively bred in Southeast Asia (Baker 2003). According to Webb et al. (2008), Thailand is the largest *P.sinensis* producer, in 1998 it produced 2 237 000 kg. In 1996 – 1998 Thailand exported 3 308 000 kg of *P.sinensis*, 500 000 young animals and 95 000 eggs of *Pelodiscus sinensis* (Chen et al. 2002, cited in: Webb et al. 2008). According to Dharmananda (2005), Thai farms produce 6 000 000 young *P.sinensis* a year. In 2002 China produced 303 000 000 *Pelodiscus sinensis* (CITES 2002, cited in: Webb et al. 2008). In Vietnam *Pelodiscus sinensis* has been bred for 15 years already (Thomson 2008). Attempts have been made to breed the species in Russia (Tagirova, Yatsenko 2008), where northernmost populations are living. In restaurants customers choose alive turtles, so *P.sinensis* are exported alive (Webb et al. 2008). Due to that larger import of the species and, consequently, their release into natural environment can be expected in future in Latvia also.

CONCLUSIONS

Pelodiscus sinensis are predators, so they can influence a wide range of local aquatic fauna in case of colonization (Somma 2008). *Pelodiscus sinensis* in many countries is displacing local species of turtles together with the most invasive turtle in the world *Trachemys scripta elegans* (Thirakhupt, Van Dijk 1994; Cadi, Joly 2003; Welcomme, Vidthayanom 2003; Cadi, Joly 2004). In Germany *Pelodiscus sinensis* is considered a potentially invasive species of large turtles (Kirschey 2000) and it has moderate risk of the invasion in the European Union (Kopecky et al. 2013).

Pelodiscus sinensis is likely to inhabit Latvia in summer, and possible, in winter. *Pelodiscus sinensis* inhabits Russian Far East, where frost-free season lasts for 150-155 days (Knystautas, Sibnev 1987, cited in: Kirschey 2000). To assess the possibility of *P.sinensis* to adapt to Latvian climate it is necessary to take into account its relatively long lifetime (up to 25 years); *P.sinensis* can hibernate under water up to 7 months (Baker 2003); and a short period of eggs incubation (only 30-50 days) (Knystautas, Sibnev 1987, cited in: Kirschey 2000), as well as the tendency to climate warming in Latvia (LVĢMA 2009) which has already a positive effect on expansion of the native reptile, *Natrix natrix* (Pupins, Pupina 2015). *P.sinensis* can be also potential sources of new parasitic diseases for autochthonic *Emys orbicularis*.

Main measures to prevent release of *Pelodiscus sinensis* into the natural environment of Latvia can be: 1) control of *P.sinensis* import and trade; 2) penalty for illegal introduction of the species into natural environment; 3) education of dwellers, especially pet lovers; 4) search of *P.sinensis* in natural environment and its removing; 5) establishment of a shelter for *P.sinensis* and other exotic turtles (Pupiņš, Pupiņa 2007). Some of the measures are realized in the Latgales Zoo, Daugavpils, Latvia and are planned for the realization.

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