

DISTRIBUTION OF *MACROBRACHIUM NIPPONENSE* (DE HAAN, 1894) (DECAPODA, PALEMONIDAE) IN THE REPUBLIC OF MOLDOVA

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ABSTRACT

Data on the distribution, abundance, biomass, and morphological features of *Macrobrachium nipponense* from 1986-2022 collected in the Republic of Moldova are presented. Maximum length of *Macrobrachium nipponense* was 117 mm, which is bigger than in other places, maximum weight was 13.8 g. The highest abundance was 12 individuals/m². *M. nipponense* dispersed from the place of introduction on a distance of 210 km. The most probable pathways of dispersal are the natural spread in the rivers, and unintentional or intentional introduction by fishponds owners in isolated ponds. Since 1986 *M. nipponense* population on our territory became tolerant to low winter temperatures of water 0.2°C-2.5°C, this fact also contributed to extension of their area and in the neighboring countries water bodies.

ZUSAMMENFASSUNG: Verbreitung des *Macrobrachium nipponense* (De Haan, 1849) (Decapoda, Palemonidae) in der Republik Moldau.

Es werden Daten über die Verbreitung, Abundanz, Biomasse und die morphologischen Merkmale von *Macrobrachium nipponense* vorgestellt, die zwischen 1986-2022 in der Republik Moldau gesammelt wurden. Die maximale Länge von *M. nipponense* betrug 117 mm, was ein größeres Maß bedeutet als an anderen Orten. Das maximale Gewicht lag bei 13,8 g. Die höchste Abundanz belief sich auf 12 Individuen/m². *M. nipponense* breitete sich vom Einschleppungsort über eine Entfernung von 210 km entlang des Flusses aus. Die wahrscheinlichsten Ausbreitungswege vom Einschleppungsort sind die natürliche Ausbreitung in den Flüssen und die unbeabsichtigte oder absichtliche Einschleppung durch Teichbesitzer in isolierte Teiche. Seit 1986 ist die Population von *M. nipponense* auf dem Gebiet der Republik Moldau tolerant gegenüber niedrigen Wintertemperaturen des Wassers von 0,2°C-2,5°C. Diese Tatsache trug dazu bei, dass sich ihr Gebiet nicht nur in der Republik Moldau, sondern auch in den Gewässern der Nachbarländer ausdehnte.

REZUMAT: Distribuția speciei *Macrobrachium nipponense* (De Haan, 1849) (Decapoda, Palemonidae) în Republica Moldova.

Sunt prezentate date privind distribuția, abundența, biomasa, și caracteristicile morfologice ale *Macrobrachium nipponense* în 1986-2022, în Republica Moldova. Lungimea maximă a *M. nipponense* a fost 117 mm, mai mare decât în alte zone, greutatea maximă – 13,8 g. Abundența maximă a fost de 12 indivizi/m². *M. nipponense* s-a răspândit pe o distanță de 210 km de-a lungul râului de la locul de introducere. Cel mai probabil răspândirea a fost cauzată de dispersarea naturală în râuri sau introducerea neintenționată sau intenționată de către proprietarii de iazuri izolate. Din 1986 populația de *M. nipponense* de pe teritoriul nostru a devenit tolerantă la temperaturi scăzute ale apei, iarna la 0,2°C -2,5°C. Acest fapt a contribuit de asemenea, la extinderea arealului lor și în corpurile de apă din țările vecine.

INTRODUCTION

The Oriental River Prawn *Macrobrachium nipponense* (De Haan, 1849) (Crustacea, Decapoda, Palaemonidae) is a subtropical freshwater prawn (Holthuis, 1980). The synonyms are: *Palaemon nipponensis* De Haan, 1849; *Palaemon asper* Stimpson, 1860; *Palaemon sinensis* Heller, 1862; *Bithynis nipponensis nipponensis* Rathbun, 1902; *Palaemon (Eupalaemon) nipponensis* Parisi, 1919 (Holthuis, 1980).

This species originated in China about one million years ago (Chen et al., 2009). The native area of this species is East Asia: China, Japan, Korea, Vietnam, Taiwan, and Myanmar (Holthuis, 1980; Cai and Ng, 2002; De Grave and Ghane, 2006; Chen et al., 2017; Zheng et al., 2019). Prawns of the genus *Macrobrachium* can be found in various water bodies: lakes, reservoirs, rivers, ponds, streams, ditches, swamps, and subterranean waters (Zheng et al., 2019). *M. nipponense* prefers water with a sandy and muddy bottom and abundant aquatic vegetation (Suprunovich and Makarov, 1990).

The entire life cycle takes place in fresh water, but larva of *M. nipponense* can successfully grow in waters with salinity up to 12.5‰ (Wong and McAndrew, 1990), waters with salinity 10‰ does not significantly affect the growth of *M. nipponense* (Kulesh, 2013). Optimal temperature for growing is 25-28°C, but it can live at the temperature range from 2-5°C in winter and up to 30-36°C in summer (De Grave and Ghane, 2006; Kulesh, 2013). In optimal conditions the Oriental River Prawn can become sexually mature in 2.5 months with minimum size of 33-34 mm in native area and in cooling reservoirs (De Grave and Ghane, 2006; Kulesh, 2013).

The total length up to 99 mm have been noted for specimens from native area (Holthuis, 1980). However, in the introduced water bodies the largest specimens can reach the total length to 10.5 cm (Vladimirov et al., 1989) and even 12 cm (Karlova et al., 1988). The average life span is 2-3 years (Ogawa et al., 1991).

The environmental tolerance of *M. nipponense* and its taste gave a possibility for cultivating it in numerous aquaculture locations all over the world, with total production of 237.1 thousand tons in 2018 (FAO, 2020). The production is higher than that of *Macrobrachium rosenbergii* (de Man, 1879), also known as the giant river prawn which was at the same period – 234.4 thousand tons (FAO, 2020).

Due to the wide ecological tolerance, this shrimp spreads quickly, and have been reported of considerably extending of their area in many countries such as: Singapore, Philippines, Uzbekistan, Kazakhstan, Turkmenistan, Iraq, Russia, Belarus, Moldova, Iran, and Ukraine (Chong et al., 1987; Vladimirov and Toderash, 1988; Alekhovich and Kulesh, 2001; Cai and Ng, 2002; Mirabdullaev and Niyazov, 2005; Cai and Shokita, 2006; De Grave and Ghane, 2006; Salman et al., 2006; Stepanok, 2014).

M. nipponense have appeared accidentally in Europe; in 1960 this prawn was inadvertently introduced to the cooling reservoir of Elektrogorsk power plant in Moscow Region, with the herbivorous cyprinid fish from the Yangtze River (Ivanov and Starobogatov, 1974). Then, in 1982 it has been introduced in Belarus in Cooling Reservoir at Berezovskaya GRES (Kulesh, 2013), and later in the Republic of Moldova.

The *M. nipponense* have been introduced in the Republic of Moldova in 1986 in the Dniester River basin, in the Cuciurgan cooling reservoir (former Cuciurgan Estuary) from Belarus (Vladimirov et al., 1989). The Cuciurgan power plant (Moldavskaya GRES) has been built in 1964 (Yaroshenko, 1973), the installed capacity of 2.520 MW has been reached in 1982 (Zelenin, 1988). Work of the Cuciurgan power plant led to an increase in the water temperature. The average annual temperature of the water increased with 6°C and was 18.2°C, in lower part of Cuciurgan reservoir winter water temperature was 10-13°C, that was two-three

times higher than normal (Yaroshenko, 1973). This increase in temperature has led to the disappearance or significant reduction in the number of various species of aquatic organisms. Thus, species diversity of the macrobenthos of the reservoir has decreased by 70 species, including Ponto-Caspian crustaceans (Vladimirov and Toderash, 1988)

The purpose of introduction of *M. nipponense* in Cuciurgan cooling reservoir was to fill a vacant ecological niche and supporting the fishery (Karlov et al., 1988; Vladimirov et al., 1989). During introduction was considered and planned that a subtropical freshwater prawn will be successfully formed an established local population and will not disperse from zones with winter temperatures 2-5°C.

The prawn, namely 2,000 individuals of it, have been introduced in April 1986 and in the end of 1987 abundance of local population reached 600 000 individuals (Vladimirov et al., 1989). In places with highest aggregation their density was over 100 individuals/m² (Vladimirov et al., 1989).

Despite their preference for thermophilic waters e.g., up to 2012 this species was populating only in the place of their introduction, but owing to their capacity to withstand low winter temperatures, it was possible to spread in other territories. The prawn has been registered in the riverbed of the Dniester River in the North up to Tiraspol (Filipenko, 2014) and in the South up to Dniester estuary (Ukraine) in 2013 (Stepanok, 2014).

During this study we analyzed the actual distribution of the Oriental River Prawn on the territory of the Republic of Moldova during 2011-2022 and factors which contribute to its spread.

MATERIAL AND METHODS

Study area

During 2011-2022 a routine sampling was performed on the water basins within the present state borders of Moldova.

On the territory of the Republic of Moldova there are four water basins such as: Dniester River basin, Prut River basin, small rivers of the Danube River basin and small rivers of the Black Sea basin (Fig. 1). The sampling was performed on above mentioned basins, at 22 common sampling stations and over 60 additional sampling stations.

On the territory of the Republic of Moldova the Dniester River is the biggest river, it has a length of 657 km. Total length of the Dniester River consists of 1,352 km. The catchment area is about 70% of the country's territory.

Cuciurgan cooling reservoir (former Cuciurgan Estuary) belongs to the Dniester River basin and situated on the border with Moldova and Ukraine, its water resources are shared between the two countries. Reservoir was created by damming the Cuciurgan River and regulation of Turunciuc River, which is a left branch of the Dniester River. The reservoir is 14-20 km long, it depends on the water level and has a width up to three kilometers. The average depth is 3.5 m, the maximum depth is five meters. It has a total water surface area of about 29 km² (Yaroshenko, 1973).

Răut River and Bîc River are the right tributaries of the Dniester River with a length of 286 km and 155 km correspondingly, both rivers are entirely located on the territory of the Republic of Moldova. Also, Bălțata River, which is a small right tributary of the Dniester River, with a total area of 153.9 km² has been studied.

The points of introduction and dispersal points were investigated (Fig. 1).

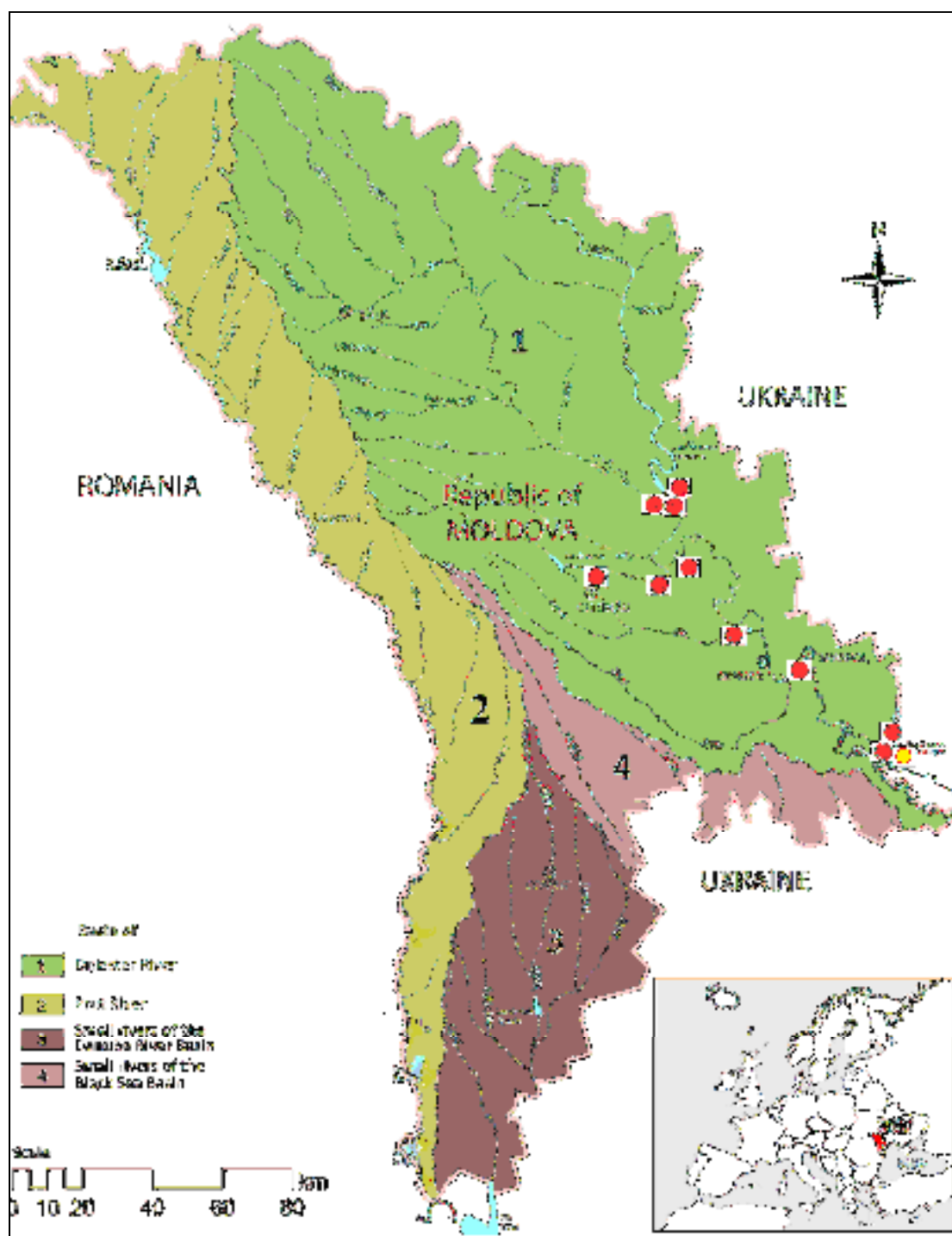


Figure 1: Map of water basins from Republic of Moldova;

- Point of *Macrobrachium nipponense* introduction: Cuciurgan cooling reservoir; ● Dispersal points from North to South: Dam of the Dubăsari hydroelectric power station, mouth of the Răut River, 2 km upstream of the Răut River, lakes in Chișinău, fishponds Gura Bîcului, fishpond situated on Bălțata River, fishpond Corjova, Tiraspol, and Turunciuc.

Collecting specimens

Sampling was performed, near the banks from a depth of 0.3-1.5 m in rivers, reservoirs, lakes, and fishponds. For sampling a dredge with a capture area of eight m² and hand net were used (Abakumov, 1983; Munjiu et al., 2020; AQEM, 2002) and also fishing drags with a six mm mesh size during samples from ichthyological studies (Davideanu, 2013). Samples were preserved by adding 37% formaldehyde or 96% ethanol. All specimens have been sorted in the laboratory and identified using identification keys (Burukovsky, 1974; Tsalolihin, 1995) and scientific publications (Salman et al., 2006; Hanamura et al., 2011).

The species identification, figures and part of measurements has been carried out with a stereomicroscope SteREO Discovery.V8 (Zeiss) and upright microscope Axio Imager A.2 (Zeiss). Other morphometric measurements have been carried out with a caliper with an accuracy of one mm. The biomass was determined via weighting on an analytical balance ABS 80-4 Kern to 0.0001 g. The prawns' density and biomass was converted into individuals/m² and g/m². Statistical analysis was performed using Excel 2010 (Microsoft) software.

RESULTS AND DISCUSSION

During this investigation, 78 specimens of *M. nipponense* have been collected and analyzed. The total number includes prawns from Dniester River, Cuciurgan Reservoir, Răut River, fishponds and lakes. The species was found at 11 sampling stations (Tab. 1).

Table 1: Location and occurrence of *Macrobrachium nipponense* (De Haan, 1849) in the Dniester River basin during 2011-2022 on the territory of the Republic of Moldova; *substrates are arranged in decreasing order of area.

Locality		Date of registration	Substrates*
Sampling stations	Lat./Long.		
Dam of the Dubăsari	47°27'01"/ 29°12'07"	2020	stone embankment, sandy, mud, gravel
Mouth of the Răut	47°14'40"/ 29°08'50"	7.09.2020	sandy, mud, gravel
Upstream two km Răut River	47°14'33"/ 29°07'20"	7.09.2020	sandy, mud, gravel
Lake Valea Trandafirilor Chișinău	47°00'06"/ 28°55'08"	2020	
Lake Valea Morilor Chișinău	47°01'04"/ 28°48'29"	3.10.2020	stone embankment, sandy, mud, macrophytes
Fishponds Gura Bîcului	46°54'47"/ 29°26'04"	2012	sandy, mud, macrophytes
Fishpond situated on Bălțata River	47°02'29"/ 29°08'07"	22.10.2020 (Munjiu, 2021)	stone embankment, mud, sandy
Fishpond Corjova	47°07'03"/ 29°18'05"	20.06. 2022	sandy, mud, macrophytes
Tiraspol	46°50'01"/ 29°36'48"	Autumn 2013 (Filipenko, 2014)	stone embankment, sandy, mud,
Turunciuc	46°38'10"/ 29°50'08"	2013 (Stepanok, 2014)	mud, sandy, macrophytes
Cuciurgan cooling reservoir (canal)	46°36'08"/ 29°56'56"	25.04.1986 (Vladimirov et al., 1989)	macrophytes, stone embankment, sandy, mud,

During 2011-2022, the prawns have been quantitatively and qualitatively sampled by dredge, hand net and fishing drag in the point of its introduction and dispersal points.

Point of the introduction: Cuciurgan cooling reservoir. Dispersal points from North to South: dam of the Dubăsari hydroelectric power station, mouth of the Răut River and two km upstream of the Răut River, lakes of Chişinău city, fishpond Gura Bîcului Village situated in the Bîc River basin, fishpond situated in the Bălţata River basin, Tiraspol (riverbed of the Dniester River), and Turunciuc River. All these sampling points are heavy modified or artificial water bodies or under heavy anthropogenic pressures.

M. nipponense has been detected in freshwaters with moderate or no current velocity in places with stone embankment, sandy-mud bottom, and macrophytes. The abundance of *M. nipponense* varied from one up to 12 individuals/m² and biomass from 0.758 up to 4.63 g/m² correspondingly. Maximum abundance and biomass were found in Cuciurgan cooling reservoir 12 individuals/m² in 21.05.2012, all prawns were females.

In 2020 these prawns firstly have been detected in tributary of the Dniester River, the Răut River and even near the dam of the Dubăsari hydroelectric power station. Thus, the distance along the river from the place of their introduction is 210 km upstream.

At the same time *M. nipponense* have been detected in fishponds of Gura Bîcului village and fishpond situated on Bălţata River (Munjiu, 2021), both belong to the Dniester River basin. The abundance reaches 3-4 individuals/m².

Over the last years this species also successfully colonized lakes in Chişinău city such as lake Valea Trandafirilor and lake Valea Morilor in urban parks, situated from 17 km from the Dniester River and isolated from this river. Three specimens with length up to 3.6 cm has been detected, therefore these being sexually mature.

Morphology

The identification of *M. nipponense* has been done according to scientific publications (Salman et al., 2006; Hanamura et al., 2011, Afanasyev et al., 2020). The main characteristic features of species are the shape of rostrum and male second pereopod. Rostrum has 10-13 dorsal teeth, including 2-3 placed posterior to orbital margin and 2-3 ventral teeth (Hanamura et al., 2011). Second pereopods sub-equal in length and similar in shape, (unlike those of other *Macrobrachium* species), about twice of total body length in larger males (carapace length >20 mm), or 1.1-1.3 times as long as the total length of the body in males, and 0.6-0.7 in females (Cai and Ng 2002; Hanamura et al., 2011). The claws of *M. nipponense* has short, dense hairs (setae) (Cai and Ng, 2002). All investigated prawns correspond to the description of species *M. nipponense*. (Figs. 2A; 2B; 2C; 3A; 3B; 4)

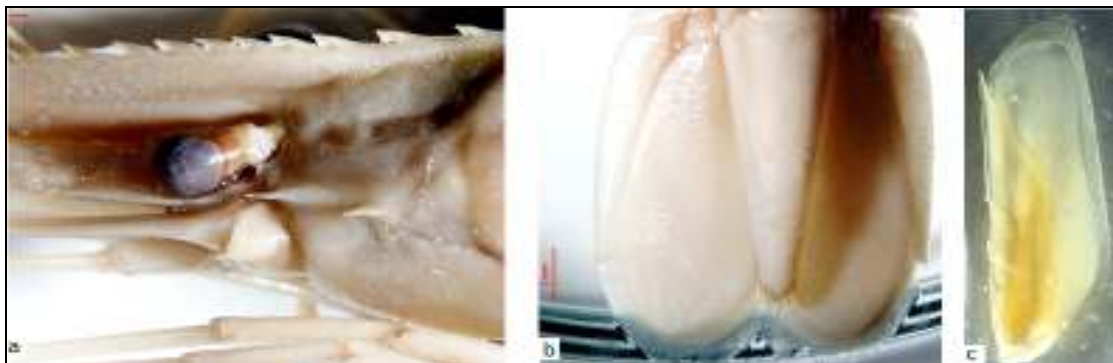


Figure 2: (a) *Macrobrachium nipponense* (De Haan, 1849) eye and carapace spines, (b) Telson, uropods, and endopods, (c) Scaphocerite. (photo by Munjiu O.)



Figure 3: Biggest individuals *Macrobrachium nipponense* (De Haan, 1849) from Cuciurgan cooling reservoir (Collection of Institute of Zoology) (A) total length 11.7 cm, ocular length 9.5 cm; (B) total length 10.5 cm, ocular length 9.3 cm. (Photo by Munjiu O.)



Figure 4: *Macrobrachium nipponense* (De Haan, 1849) from the Răut River. Total length 5 cm. (photo by Bulat Dm.).

However, some specimens have some different characteristics from the specific diagnostic patterns of the species (Salman et al., 2006; Hanamura et al., 2011, Zheng et al., 2019, Afanasyev et al., 2020) – e.g., a bigger number of dorsal and ventral teeth (Fig. 5A; 5B).

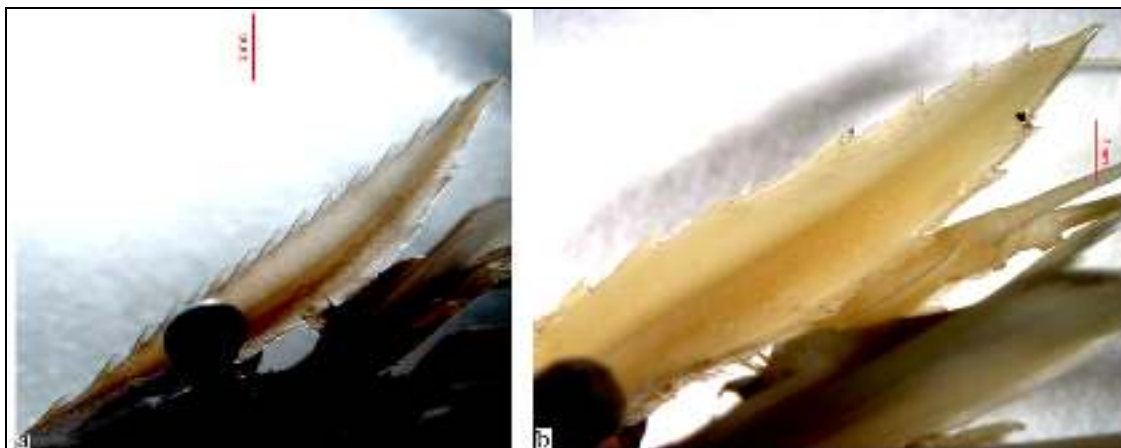


Figure 5: (a) Rostrum with 15 dorsal rostral teeth. (b) Rostrum with four ventral teeth. (photo by Munjiu O.)

The rostral formula is 10-13 dorsal teeth and 2-3 ventral teeth by Hanamura et al., (2011); 11-13 and 2-3 by Afanasyev et al. (2020), and 2-3+7-10/2-3 equal 9-13 dorsal and 2-3 ventral teeth by Cai and Ng (2002). Minimum number of dorsal teeth in the found specimens was 12, maximum number of ventral teeth was 4. This is not connected with growth, because in the found specimens with 4 ventral teeth an individual had a total length of 3.9 cm and those with 15 dorsal teeth had individuals with a total length of 2.2; 5.2 and 7.7 cm (Tab. 2).

According to the obtained results, the total length (TL) of the *M. nipponense*, measured from tip of the rostrum to the posterior margin of the telson, ranged from 20 mm to 117 mm. The ocular length was measured from the posterior margin of the orbit to the tip of the telson.

The morphometric analysis has been done on the base of 45 specimens of *M. nipponense* collected from Cuciurgan cooling reservoir and fishpond Corjova (Tab. 2). Considering the fact that a sexually mature prawn has a total length of more than 33-34 mm, all specimens were divided into IV length groups, beginning from the smallest group with ocular length of 1.7 to 3.30 cm to the biggest group with ocular length of 9.3 to 9.5 cm.

Table 2: Morphometric and weight measurements of the *M. nipponense* on the territory of the Republic of Moldova; N – number of specimens measured; Min – minimal value; Max – maximal value; Mean – mean value; Weight – g; SD – standard deviation; Number of specimens = 45 from 78 investigated specimens, the others specimens were partially damaged and were not measured.

Groups	Number of specimens N=45*	Ocular length (cm)	Number of rostrum dorsal teeth	Number of rostrum ventral teeth	Weight (g)
I	7				
Mean ± SD		2.20 ± 0.58	13.43 ± 1.13	3.14 ± 0.38	0.27 ± 0.17
Min-Max		1.7-3.3	12-15	3-4	0.056-0.498
II	29				
Mean ± SD		4.55 ± 0.70	13,56 ± 0,87	3.07 ± 0.37	1.62 ± 0.64
Min-Max		3.5-5.8	12-15	2-4	0.721-2.95
III	7				
Mean ± SD		7.51 ± 0.79	13,33 ± 1.21	3	5.47 ± 1.92
Min-Max		6.3-8.7	12-15	3	3.62-8.37
IV	2				
Mean ± SD		9.4 ± 0.14	13 ± 1.41	4	12.87 ± 1.32
Min-Max		9.3-9.5	12-14	4	11.93-13.80

The most numerous group was IInd (medium size) consisting of 29 specimens. The IVth biggest group had only two specimens. The smallest group consisting of seven specimens and IIIrd group consisting of seven specimens the same. The weight varied from 0.056 g of the smallest specimen to 13.8 g of the biggest one.

Holthuis (1980) reported that the maximum length of the species as 75 mm for the females. Salman et al. (2006) reported the maximum length of *M. nipponense* male of 9.4 cm. The biggest specimen from the Collection of Institute of Zoology is bigger than above mentioned specimens, with a total length of 11.7 cm, ocular length of 9.5 cm, carapace length of 3.1 cm and length of the second pereopods of 12.1 cm.

Thus, length of the second pereopods in largest males was in 1.03 times as long as the total length of the body this ratio is less than in those from the native area where length of the second pereopods was 1.1-1.3 times as long as the total length of the body in males.

The increasing number of rostrum teeth and total length and decreasing length of the second pereopods can be possible morphological adaptation to the local ecological conditions.

DISCUSSION

During this investigation, current distribution and possible pathways have been analyzed. According to the obtained results *M. nipponense* has been detected in different types of water bodies on the territory of the Republic of Moldova: reservoirs, rivers, lakes, and ponds with different substrates: stone embankment, sandy, mud, gravel and macrophytes.

Main environmental and anthropogenic factors which contributed to the spread of *M. nipponense* on the territory of the Republic of Moldova are the following: introduction in Cuciurgan reservoir, the Dniester River basin; unintentional or intentional introduction by fishpond owners and aquarists into different waterbodies; temperature change in Cuciurgan and nearest waterbodies, wide ecological tolerance *M. nipponense* to temperature and salinity, including tolerance for low winter temperature, lower than (2-5°C) previously noted by De Grave and Ghane (2006) and Kulesh (2013). During our investigation the temperature in Cuciurgan varied from 0.2°C to 35°C, in Low Dniester River from 1°C to 28°C and in Răut River from 2.5°C to 27.6°C. Thus, *M. nipponense* population on the territory of the Republic of Moldova is tolerant to low winter temperature. Their population needed a minimum of 14 years for adaptation to such temperatures. Additional factors which contributed to this process is the climate changes, such as increasing in temperature in our region by 0.8-2.5°C (IPCC, 2013).

Also, we can mention about their adaptation to salinity, as this parameter varied over the years: in 70-ies the mineralization in Cuciurgan reservoir was 575-718 mg/l (Yaroshenko, 1973), then in 2008 it increased up to a maximum of 4,400 mg/l (Zubkova, 2008), in 2011-2015 it varied from 1,351 to 3,878 mg/l (Tihonencova, 2016). As noted by Wong and McAndrew (1994), *M. nipponense* can adapt to salinity change within only three generations. At the same time the level of the general pollution was also increased. Due to Cuciurgan thermal power station, which burned annually from 1981 to 1991 about five million tons of fuel, this negatively influenced the quality of the water body (Tihonencova, 2016). Thus, damming, increasing in the water temperature and pollution have led to the degradation of Cuciurgan water body and caused a significant reduction in the abundance of different hydrobiont species and disappearance of sensitive species (Vladimirov and Toderash, 1988). Under such conditions the introduction of freshwater prawn seemed reasonable. As a result, *M. nipponense* formed a well-established population in the Cuciurgan cooling reservoir and until 2000 have been located only there as was planned during introduction. However, later, reduction of electric power generation by Cuciurgan thermal power station contributed to decreasing of water temperature in the reservoir. At the same time, due to global warming, the water temperature of the Turunchuk branch, the main source of water supply of the Cuciurgan reservoir, increased. These factors contributed to the invasion of the prawn of the Turunchuk and Dniester rivers.

Reports about the occurrence of this species in the Dniester River delta was reported by the local fishermen in 2000s (Son et al., 2013). One of the reasons of the prawn absence during official monitoring expeditions was most probably linked to the absence of specialized

methods for the standard ecological monitoring of non-native decapods (Son et al., 2013). Officially it was reported in Dniester Delta (Ukraine) in 2009 (Son et al., 2013) and Dniester Estuary (Ukraine) (Stepanok, 2014). Twenty-seven years later, after introduction of *M. nipponense* (in 2013), specimens of this species were found upstream of the riverbed of Dniester River, near Tiraspol, thus one can assume that the dispersal rate was 2.5 km per year (Filipenko, 2014).

Since 2012 the *M. nipponense* was regularly noted in fishpond Gura Bîcului locality situated in the Bîc River basin according to their official site (*). The prawns were unintentional or intentional introduced by fishponds owners. A similar situation most probably happened in the fishpond situated in the Bălțata River basin and lakes of Chișinău city.

The distribution of *M. nipponense* in the lakes of Chișinău area, the waterbodies, located 17 km from the Dniester and isolated from the rivers, is largely associated with the release of prawn into natural waterbodies by aquarists. In other ponds, it can have been brought by the owners owing to their delicious taste and economic value or by spreading from the Dniester River. Spreading from the Dniester River was most probably via the Răuț River pathway, as it was found two km upstream of the Răuț River in 2020 and near the dam of the Dubăsari hydroelectric power station. Here we should note an information from local fishermen about appearance of *M. nipponense* in summer 2022 in the Lower Prut, including some fishpond of the Prut River basin (Bulat D. personal communication). This happened possible, due to introduction of these prawns by the fishpond owners. (Surugiu, 2022)

Considering wide ecological tolerance and quick spread of this prawn beyond the limits of its introduction of Cuciurgan reservoir it is possible to expect an impact on the native fauna. The Oriental River Prawns are omnivorous, 20% of their food spectrum consists of invertebrates including: insect larvae, oligochaetes, and small mollusks (Kulesh, 2013). Also this species can feed on the detritus, algae, aquatic plants, crustaceans, and fish. Therefore, it may be an additional predator and concurrent species for native decapods.

On the territory of the Republic of Moldova the main problem with assessing the possible impact of *M. nipponense* on native fauna is difficulty in separation of the impact of the species itself on native biodiversity from the impact of the high anthropogenic pressure on water bodies. Especially this is characteristic for Cuciurgan cooling reservoir as this species was unfortunately introduced to fill a vacant ecological niche.

On the base of the current investigation, it is possible to predict further expansion of the area of the Oriental River Prawn in our region. That can be confirmed by finding of this species in Ukraine's inland waters not only in Dniester River basin (Son et al., 2013; Stepanok, 2014; Son et al., 2020), but even in Danube River basin in Ukraine (Zhud et al., 2022), and Romania (Surugiu, 2022), as well as in several small river basins and estuaries of this regions.

CONCLUSIONS

The occurrence of established wild populations of *M. nipponense* in Lower Dniester River, Răuț River and some lakes in the Dniester River was shown, currently it becomes a common species of the macrobenthos on the territory of the Republic of Moldova.

M. nipponense dispersed along the river from the place of its introduction (Cuciurgan cooling reservoir) on 210 km or 351 km on the North from the mouth of Dniester River and 70 km on the South to the Dniester Delta (Ukraine). *M. nipponense* appeared in some fishpond in the Prut Basin, this situation should be considered in the regional conservation programs for wetlands.

Since 1986 *M. nipponense* population on the territory of the Republic of Moldova became tolerant to low winter temperatures of water 0.2°C-2.5°C, lower than (2-5°C) previously noted, in spite of the fact that prawns are thermophilic animals, this fact contributed to an extension of their area not only in Moldova but on the neighboring countries. The Oriental River Prawn in our country inhabit water bodies with mineralization values of 327-4.400 mg/l.

The environmental and anthropogenic factors contributed to the spread of *M. nipponense* on the territory of the Republic of Moldova such as: introduction in Cuciurgan; unintentional or intentional introduction by fishponds owners and aquarists; temperature change in Cuciurgan reservoir and nearest waterbodies, increasing temperature in our region by 0.8-2.5°C, and also wide ecological temperature and salinity tolerance of *M. nipponense*.

All investigated prawns correspond to the description of species *M. nipponense*. However, some specimens differ slightly by the number of dorsal and ventral teeth, this can be possible morphological adaptation to local ecological conditions.

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