

ABUNDANCE AND CHARACTERISTICS OF POPULATION OF BROWN BULLHEAD (*Ameiurus nebulosus*) IN DOMASZNE LAKE

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Abstract. The brown bullhead (*Ameiurus nebulosus*) is an invasive species of fish fauna in Poland. This species is widespread throughout the country but its abundance and characteristics of populations present in water reservoirs are relatively little known. Aim of this study was to determine the abundance and characteristic of the population of brown bullhead in the Domaszne Lake. The control fish catches were carried out three times in 2012 and 2013 years (spring, summer, autumn). Brown bullhead had a small share in the structure of fish abundance (2.7%) and biomass (7.5%), but his presence was reported in results of all control fishing. Relative abundance of brown bullhead averaged about 7.8 CPUE and biomass about 505.5 WPUE. The fishes the greatest total length and weight had in the spring (TL = 18.5 cm, W = 77.7 g) but the highest value of the coefficient of condition (K = 2.08) in summer were noted. Brown bullhead with a total length from 16 to 18 cm accounted for as much as 59% of the population and distribution of size structure confirm a fact that has a stable population.

Key words: brown bulhead, *Ameiurus nebulosus*, invasive species, ichthyofauna, Domaszne

INTRODUCTION

The brown bullhead (*Ameiurus nebulosus*) is one of such species, which in Poland is treated as an invasive [Grabowska *et al.* 2010]. In the XIX century this fish species was imported from North America into Poland and several other European countries for breeding and fishing [Adamczyk 1975, Andrzejewski 1994].

This species was rapidly adopted and spread thanks to such features as small habitat requirements and wide food preferences, care of the eggs and fry, resistance to invasions of parasites, and lack of natural enemies [Kornijów 2001, Kornijów *et al.* 2003, Grabowska and Przybylski 2015].

According to Głowaciński *et al.* [2008] brown bullhead is present in many inland waters across the Poland. In the late twentieth century some papers have shown that the brown bullhead especially often occurs in the Lublin region [Witkowski 1996] both in the rivers [Danilkiewicz 1973], as well as in lakes [Adamczyk 1975, Radwan *et al.* 1987, Kolejko 1998a, 1998b]. Moreover, in recent years, in several lakes of Łęczyńsko-Włodawskie Lakeland this species was noted [Kornijów *et al.* 2003, Płaska and Rechulicz 2008, Kolejko 2010, Rechulicz 2011, 2012].

The informations of the occurrence of brown bullhead in Polish water bodies are generally qualitative. In addition its abundance and characteristics of populations present in water reservoirs are relatively little known. Aim of this study was to determine the abundance and characteristic of the population of brown bullhead (*Ameiurus nebulosus*) in the Domaszne Lake.

MATERIALS AND METHODS

The study was conducted in the Domaszne Lake (N 51°28', E 23°0') situated in the Łęczyńsko-Włodawskie Lakeland and included into the Wieprz-Krzna Channel system. The lake has an area of 95 ha, the capacity of 2208 thousand m³ and is relatively shallow, (max. depth – 3.1 m). Domaszne is a polymictic and eutrophic lake, and according to the fishery classification is tench-pike lake type [Harasimiuk *et al.* 1998]. A fishing user of this lake is the Jedlanka Fish Farm.

In Domaszne Lake, three times in 2012 and 2013 years (spring, summer, autumn) control fish catches were carried out. Catches were conducted using standard multi-mesh gillnet type (1.5 m deep, 30 m long, 12 mesh sizes 5 mm to 55 mm knot-to-knot) [Appelberg 2000, CEN document 2005]. Nets time exposition was between 6 and 12 hours (6 hours in day and 12 hours at night).

All caught fish were determined to species, their total length (TL), standard length (SL) (in cm) and body mass (W) (in g) were measured. Stability of species occurrence (C_i) was calculated by the following formulas:

$$C_i = 100 \cdot s_i / s_t$$

where: s_i – number of samples where species 'i' was present, s_t – total number of samples.

The species richness and the dominance index ($D_i\%$) and biomass dominance index ($W_i\%$) of brown bullhead were calculated using following formulas:

$$D_i(\%) = 100 \times n_i / N,$$

$$W_i(\%) = 100 \times w_i / W;$$

where: n_i – number of brown bullhead individuals, N – total number of all fish, w_i – biomass of brown bullhead, W – total biomass of all fish. Moreover the

coefficient of condition of brown bullhead was estimated using Fulton formula $K = 100000W/SI^3$; where W – body mass (in g), SI – standard length (in mm) [Williams 2000].

The all fish data obtained in control fishing were converted to catch per unit effort (NPUE and WPUE). For the abundance, the NPUE, it was the number per unit effort, i.e. number of fish individuals caught in the one net after 12 hour fishing ($\text{ind. net}^{-1} 12 \text{ h}^{-1}$), and for the fish biomass, WPUE, it was weight per unit effort, i.e. fish biomass (in grams) of the fish caught in one net after 12 hour fishing ($\text{g net}^{-1} 12 \text{ h}^{-1}$).

The brown bullhead abundance, total length, biomass and coefficient of condition in the each year and seasons of research using analysis of variance (ANOVA) were compared at a significance level of $p \leq 0.05$. In addition, in the order to determine the status of population of brown bullhead the normality of the distribution of total length was checked (Shapiro-Wilk test) and the length-weight relationship regression equation was determined.

RESULTS

In the Domaszne Lake the presence of 14 species of fish belonging to 4 families (*Cyprinidae*, *Percidae*, *Esocidae* and *Ictaluridae*) was noted. The species richness of fish ranged from 10 to 11. The brown bullhead was present in the Domaszne Lake in both years in each sample of control fishing ($C_i = 100\%$).

The average abundance of brown bullhead reached 7.79 CPUE and was not statistically different depending on the year and season (ANOVA, $p > 0.05$) (Table 1). The biomass of brown bullhead averaged 505.5 WPUE and was slightly higher ($p > 0.05$) in the second year of the study (610.17 WPUE) (Table 1).

Table 1. Relative number (NPUE) and biomass (WPUE), abundance (D%) and participation in total fish biomass (W%) of brown bullhead in Domaszne Lake

Year	Parameters	NPUE	WPUE	D%	W%
2012	Mean	5.67	400.83	3.12	8.39
	Range	0.75–11.50	31.00–766.00	0.59–5.32	1.23–13.79
	SD	5.40	367.52	2.38	6.46
2013	Mean	9.75	610.17	2.27	6.54
	Range	4.75–14.00	372.00–764.00	1.32–3.41	5.19–7.45
	SD	4.67	209.20	1.06	1.19
Total	Mean	7.79	505.50	2.69	7.46
	Range	0.75–14.00	31.00–766.00	0.59–5.32	1.23–13.79
	SD	5.00	290.99	1.71	4.27

In abundance the share of brown bullhead ranged from 0.59% (autumn 2012) to 5.32% (summer 2012) and for the entire study reached 2.69%. The averaged participation of brown bullhead in the total biomass of fish reached 7.46% and was slightly higher in the first year of the study (8.39%) (Table 1).

The length and body mass of fish varied depending on the season (ANOVA, $df = 77$, $F = 5.948$, $p = 0.004$). The highest mean total length and mean body weight the brown bullhead had in spring, 18.45 cm and 77.75 g, respectively (Table 2). The coefficient of condition calculated for brown bullhead from the Domaszne Lake averaged 2.01, and was not statistically different depending on the year. While its highest value was noted for fish caught in summer ($K = 2.08$) (ANOVA, $df = 77$, $F = 7.45$, $p = 0.001$) (Table 2).

The distribution of the total length of brown bullhead population from Domaszne Lake was normal (Shapiro-Wilk test; $W = 0.977$; $p = 0.168$) (Fig. 1). The fish with a total length between 16 cm to 18 cm accounted for about 59% of the population of the brown bullhead. Regression analysis showed the length-weight relationship of population of brown bullhead by the equation $W = -138.57 + 11.73^{TL}$.

Table 2. Total length (TL), body mass (W) and coefficient of condition (K) of brown bullhead in Domaszne Lake; SD – standard deviation ($N = 78$)

Season	TL (in cm)			W (in g)			K		
	Mean	Range	SD	Mean	Range	SD	Mean	Range	SD
Spring	18.46 ^A	15.30–23.00	1.86	77.75 ^A	33.00–148.00	26.78	2.02 ^A	1.50–2.76	0.23
Summer	17.39 ^A	14.50–21.50	1.74	66.50 ^A	39.00–114.00	18.90	2.08 ^A	1.61–2.55	0.24
Autumn	16.39 ^B	12.30–19.00	2.33	50.60 ^B	17.00–75.00	20.98	1.75 ^B	1.39–2.30	0.24
Total	17.80	12.30–23.00	2.00	70.14	17.00–148.00	24.86	2.01	1.39–2.76	0.25

^A Means in the column with the same letter – no statistical differences

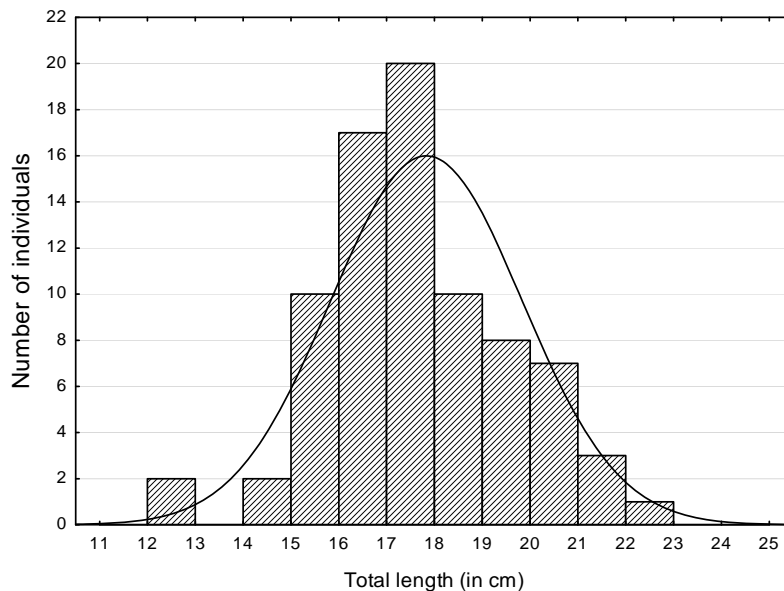


Fig. 1. Distribution of total length (TL; in cm) of population of brown bullhead from Domaszne Lake ($N = 78$)

DISCUSSION

The investigations of invasive species are a valuable source of information about their occurrence and ecology and in the long time and repeatability allow determining their potential impact on aquatic ecosystems. Although, we have a general information about the presence of a brown bullhead in the water bodies across the Poland, however there is no information about a local populations of this species. From other regions of the country, we only have information about the presence of brown bullhead in the fish community, whereas there is no knowledge about the state of the local populations [Kolejko 1998a, 1998b, Kornijów *et al.* 2003, Płaska and Rechulicz 2008, Kolejko 2010]. However Głowaciński [2008] has reported that in Poland in last years, the fading away of this species (eg. in Warta River) were noted.

These observations showed that the number of brown bullhead in the Domaszne Lake is similar to the number recorded previously in other reservoirs in the region. Kornijów *et al.* [2003] in five lakes of Łęczyńsko-Włodawskie Lakeland determined the number of brown bullhead ranging from 0.14 NPUE (Syczyńskie Lake) to 32.2 NPUE (Głębokie Uścimowskie Lake). For all examined lakes by these authors the relative mean abundance was 3.5 NPUE. In our research the abundance of this species ranged from 0.75 to 14 NPUE, an average of 7.79 NPUE (Table 1). However, the important is that in both years, total abundance and biomass of brown bullhead was at a similar level, and differences was observed only in fish size (TL and W) and condition depending on the seasons.

Research conducted on some water reservoirs showed, that if this species is present, in extreme cases, may constitute up to 70% of the total number of fish [Kornijów *et al.* 2003]. A total biomass caught in fyke nets (the most effective fishing tools for this species [Rechulicz 2006], in some lakes may be up to six tons [Rechulicz 2012]. However, in most reservoirs in this region, brown bullhead has a share about 10% of the abundance of all fish [Kolejko 2010]. According the observation of Kornijów *et al.* [2003], this may have a relationship with a lake trophy, because in several lakes the share of brown bullhead in the abundance and biomass of fish was inversely proportional to the lake trophy.

The differences in mean body weights and condition of brown bullhead depending on the seasons, can be explained by through their life cycle. Significantly higher body mass of brown bullhead in spring were probably due to the presence of individuals just before spawning, with the eggs present in their bodies [Rudnicki 1989, Brylińska 2000]. Another factor affecting to their relatively higher weight in the spring, may be the potential availability of fry and eggs, as their food [Rudnicki 1989]. In addition, slightly higher values of coefficient of condition reported during the summer can provide the best conditions of food for this species at this time (Table 2). Simultaneously, fish from the Domaszne Lake have a better condition compared with fish from other lakes of this region. This may mean that potentially smaller share of brown bullhead in the fish communi-

ty favors less food competition and better utilization of food niche, than in the case where the share of this species is bigger. Furthermore, Kornijów *et al.* [2003] examining several lakes with different trophy status has found, that average body mass and condition of brown bullhead increasing with increasing the lake trophy.

The body size structure of brown bullhead is the one of the characteristics of the population used to assess of her status. The largest share of individuals with an average body length (16–18 cm – approx. 59% of the population) and the normality of the distribution of the length (Fig. 1) found in the present study confirm, that this population is stable [Krebs 2009]. Additionally it was confirmed by presence of this species in all catches, even though in small numbers.

CONCLUSIONS

- The brown bullhead is a constant element of the fish fauna of the Domaszne Lake and on their quantity did not affect either year and season of research.
- The participation of brown bullhead in fish abundance has averaged about 2.7%, and in the structure of the biomass of about 7.5%.
- Brown bullhead has a largest body mass in the spring but the highest value of condition coefficient they had in summer.
- Analysis of the body size structure of the population of a brown bullhead in the Domaszne Lake showed that it is a stable population.

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LICZEBNOŚĆ I CHARAKTERYSTYKA POPULACJI SUMIKA KARŁOWATEGO (*Ameiurus nebulosus*) Z JEZIORA DOMASZNE

Streszczenie. W Polsce sumik karłowaty (*Ameiurus nebulosus*) jest inwazyjnym gatunkiem ryby. Powszechnie występuje na terenie całego kraju, ale o jego liczebności i charakterystyce populacji wiemy niewiele. Celem pracy było ustalenie liczebności oraz charakterystyka populacji sumika karłowatego (*Ameiurus nebulosus*) w jeziorze Domaszne. Odłowy kontrolne ryb przeprowadzono w okresie dwóch lat (2012 i 2013), w trzech sezonach (wiosna, lato i jesień). Sumik karłowaty miał niewielki udział zarówno w strukturze liczebności ryb (2,7%), jak i w biomase (7,5%), ale jego obecność notowana była w każdym sezonie połowowym. Jego liczebność wynosiła średnio 7,8 CPUE, a biomasa 505,5 WPUE. Największą masę ryby miały wiosną, a największą wartość współczynnika kondycji ($K = 2,08$) w lecie. Ryby o długości całkowitej w przedziale 16–18 cm stanowiły aż 59% badanej populacji, a rozkład struktury wielkości wskazuje, że jest to populacja stabilna.

Słowa kluczowe: sumik karłowaty, *Ameiurus nebulosus*, gatunek inwazyjny, ichtiofauna, Domaszne