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DIETARY COMPOSITION OF EURASIAN OTTER (*LUTRA LUTRA* LINNAEUS, 1758) IN THE EASTERN RHODOPE MOUNTAINS (BULGARIA)

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Abstract

Eurasian otter as a specialised carnivore on hydrobionts is often a subject of speculative believes from fishermen and fishery farmers. Dietary analysis of this species was performed by remnants of bones, scales, feathers and other undigestible components in the faeces. Collected in the Eastern Rhodope Mts. otter spraints showed the species composition, weight, percentage, and size and age composition of the preyed animals (mostly fishes). Food preferences of otter populations in the area and the importance of this species for the hydrobionts were analysed and evaluated. Otter's ecological plasticity was examined with regard to nutrition, in dependence on habitat's type and available food base. We found that the most preferred fish preys are with medium body size 10–12 cm and weight 80–90 g. The main fish species in the studied area are the chub, barbel and nase, and additional are the bleak, perch, roach, silver carp, bitterling, sunfish and ruffe.

Key words: diet analysis, food preferences, feeding habits, prey fish size.

Introduction

The Eurasian otter (*Lutra lutra* Linnaeus, 1758) (Carnivora: Mustelidae) is a top predator found in many aquatic and wetland ecosystems. As the highest level of food pyramid, the otter, and more precisely the condition of its population, is used as a biological indicator for the state of the environment (Chanin 2003a). The presence of a stable population of this species is a mandatory criterion in categorising a territory as prior according to the Ramsar Convention.

The otter is one of the most endangered mammals in much of Europe (Mason and Macdonald 1986). In spite of several studies, the status of its population is not known from many parts of its range (Roos et al. 2015). This makes it an interesting object for studying.

The otter suffered a rapid decline in the second half of the 20th century due to the wrong understandings about its harm-

fulness and the pursuit of fishermen, fish breeders and hunters (Spiridonov and Spassov 1998, Poledníková et al. 2013), the intensive hunting and poaching (Georgiev 2007, Almeida et al. 2012), and also because of the wide introduction of organochlorine groups of insecticides in the agriculture. As a result of the chemical contamination the otter lost a huge part of its areal – over 90 % (Chanin 2003b). The destruction of riverine habitats as result of water captation, riverbed corrections, and water abstraction also are important anthropogenic factors (Pandakov et al. 2017).

The otter is strictly protected under the Bulgarian and international legislation and conventions. It is currently protected by the Law for biological diversity (LBD 2002), Annex 3 and Annex 2. In the first edition of the Red Data Book of Bulgaria the otter is listed as 'threatened with extinction species' (Spassov and Spiridonov 1985). In the new edition the species is classified as 'vulnerable' (Spiridonov and Spassov 2015). It is also included in the Tariff for compensation in causing persistent damage to protected natural objects (1980). As an endangered in European scale species the otter is protected under the Criminal Code of the Republic of Bulgaria (Spiridonov and Spassov 1998, Georgiev and Koshev 2006). It is included in the IUCN Red List as Near Threatened (NT), Appendix I of CITES, Appendix II of the Bern Convention (strictly protected species) and in Annexes II and IV of the EU Habitats and Species Directives (Roos et al. 2015).

As a result of different by nature and intensity factors (climatic, geological, biological, anthropogenic) Bulgaria is one of the few European countries with a relatively well preserved otter population. In Bulgaria the species is widespread throughout the country (including the Black Sea coast), with exception of Dobrudzha, a large part of Ludogorie region and the high mountains. In the mountains the otter reaches 1500 m a.s.l.

The selection of the Eastern Rhodopes was connected with the fact that there is one of the best preserved otter populations not only in Bulgaria but also in Europe (Spiridonov and Spassov 1989, Borisov 2002). There its presence is registered in some mountainous river stretches – the most high-water sections of the rivers of Krumovitsa and Varbitsa, Arda River, and near the large dams, devoid of human presence and disturbance, as Studen Kladenets Dam (Borisov 2002, Georgiev 2006). In the past this species has been widely distributed on the territory of the Eastern Rhodopes, but after the urbanization and changes in the river regimes, the development of mines and clearing of forests, the otter was gradually pushed out from a bigger part of its natural distribution range.

Diet composition analysis is convenient to establish links with other groups of organisms and feeding plasticity of the otter, depending on the type of the habitat and the available food base. The analysis of spraints' (faeces) content or food remnants is very convenient, and sometimes the only possible method for studying secretive or nocturnal animals, such as the otter (Putman 1984, Ruiz-Olmo et al. 2001).

This study aims at exploring the particularities in the feeding of otter population in the Eastern Rhodope Mts. The implementation of diet analysis seeks to establish the links with other groups of organisms and dietary characteristics of the otter depending on the type of habitat and available food base. In this connection, the main purposes of the work are: per-

forming of detailed analysis of the dietary spectrum of the otter and its peculiarities related to the characteristics of the area, and mapping of this species in this region through found food remnants.

Material and Methods

Periods of the study and basic groups of sampling plots

For the purposes of the study during the period from 29 March 2003 to 06 May 2003 were selected the main groups of sections on the territory of the Eastern Rhodopes, covering: i) the valley of the river of Arda; ii) major tributaries of Arda River (the rivers of Varbitsa, Krumovitsa, etc.); iii) Byala Reka River (and its tributaries including the river of Luda Reka); iv) dams (medium sized – with perimeter 3–7 km, and large – with a perimeter of over 7 km); v) other basins (micro dams, channels, pools of pumping stations).

For the investigation 28 sections of different in nature basins with total length of 99.3 km were selected. They were explored by the 'positive and negative sites' method, proposed by Mason and Macdonald (1983, 2004). The longest of sections was 22.4 km, although the presence of the otter was established in all transects within 600 m. The shortest stretch was 348 m.

Material for the realization of the analysis was collected from 6 sections characterized with a presence of water quantity even during the period of low water level – 3 from the valley of Byala Reka River, 2 along Arda River and 1 from Krumovitsa valley (Table 1).

Table 1. Sections from the rivers in the Eastern Rhodopes used for the dietary analysis.

Code	River	Location	Date of visiting
BR1	Byala Reka	Near the road to Zhelezari village	
BR2	Byala Reka	Near Siv Kladenets village	29 March–1 April 2003
BR3	Byala Reka	Near Meden Buk village	
A1	Arda	Between the walls of Studen Kladenets and Ivailovgrad Dams	2–6 May 2003
A2	Arda	Along the banks of the river before Kardzhali Dam	23–26 May 2003
K	Krumovitsa	From the village of Stari Chal to the village of Potochnitsa	1–2 May 2003

Analysis of the dietary spectrum

During the field investigation of the transects, in each group of sections otter spraints or food remnants (if found near the spraints) were collected. Spraint analysis was carried out using standard methods recommended by Webb (1976). Accordingly, faecal material was collected in small individual bags, the contents of which were washed with water afterwards through a sieve to remove the unnecessary impurities. In the next step samples were dried and broken up by hand, and identifiable prey items were separated. The solid components were divided in groups – scales, fish bones, crabs remains, bones of amphibians, birds and others. Then the materials from each group were analysed (for the fishes – species, body length (TL, cm), weight (g) and age (years); for the other groups of animals – only taxonomic

belonging) and the number of individuals of a given species in each sample was designated. Species, size and age of the fishes were determined by using comparative osteological (mostly cranial) collections and specifics in the morphology of the scales and vertebrae.

The marking of otter territory has its particularities, namely each individual has preferred latrines and in many cases the spraints accumulate in heaps. Thus, after a certain period it is extremely difficult to separate individual excrement, as under the influence of environmental conditions, they lose their shape and deteriorate. Therefore, the exact number of individual spraints used for the analysis is not clear.

Results and Discussion

We found signs for the presence of otters (spraints) in all 28 surveyed river sections. Therefore, the 'positive' sites are 100 % of the studied areas. Studied sections along with the data of other sources are presented on Figure 1.

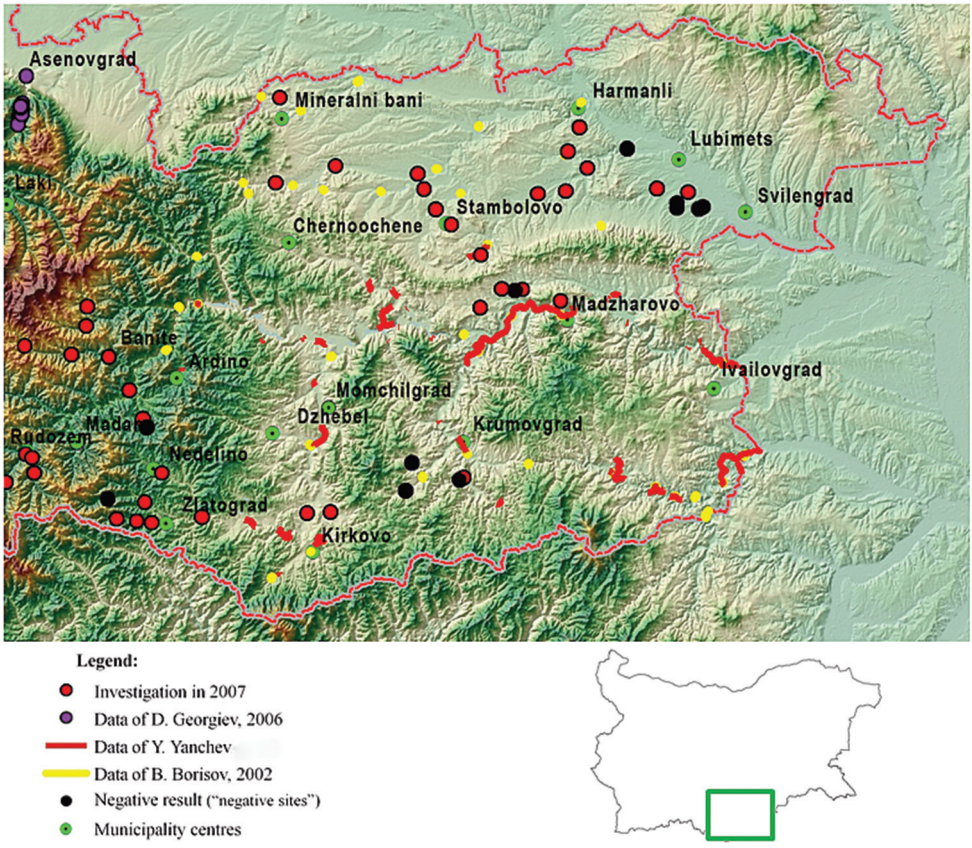

Fig. 1. Distribution of the otter in the Eastern (and partly Central) Rhodopes. The results from the present study are marked with red line (Y. Yanchev). The other data were established by Borisov (2002), Georgiev and Stoycheva (2006b) and Georgiev (2007).

Received during the field trips data suggested that the diet of otters in the studied areas includes 10 fish species (7 species from the family Cyprinidae, 2 from Percidae and 1 from Centrarchidae), 1 frog species, 1 crab species and a water beetle from the family Dytiscidae. Specimens of the Cyprinidae family were the major prey also in the study of Geidezis (1996), as in other studies in eutrophic lakes and streams (Wise et al. 1981, Jacobsen and Hansen 1996, Hofmann and Butzeck 1992). The cyprinids seem to be preferred by the otter in cold seasons probably due to their lower activity, which makes them an easy prey (Georgiev 2004).

The lack of some typical for the basins in the area fish species, found in specialised ichthyological studies (Kodzhabashev et al. 2009), enforces further purposive studies clarifying the specific causes which may be natural or resulting from the anthropogenic changes.

The results of the analysis are presented in Table 2 as for the fishes there are included the age, average weight and average size (body length). The percentage of the preys (as number of individuals) in the otters' spraints is demonstrated on Figure 2.

Table 2. Composition of the otter's diet.

Species	Section	BR1	BR2	BR3	A1	A2	K
Rutilus rutilus (Linnaeus, 1758) Roach (Cyprinidae)	Specimens	-	-	-	5	3	4
	Age, years	-	-	-	3	4	3
	Weight, g	-	-	-	28	32	30
	Length, cm	-	-	-	10–12	11–13	11–12
Squalius orpheus Kottelat & Economidis, 2006 Orpheus chub (Cyprinidae)	Specimens	10	17	7	4	5	11
	Age, years	3	3	3	4	3	3
	Weight, g	60	60	40	100	65	72
	Length, cm	13–15	12–16	12–13	14–17	13–16	14–16
Chondrostoma vardarense Karaman, 1928 Vardar nase (Cyprinidae)	Specimens	7	-	-	4	-	6
	Age, years	2	-	-	2	-	3
	Weight, g	70	-	-	70	-	90
	Length, cm	14–16	-	-	14–16	-	15–16
Barbus cyclolepis Heckel, 1837 Round-scaled barbel (Cyprinidae)	Specimens	9	10	5	7	11	12
	Age, years	3	3	2	2	2	2
	Weight, g	40	40	31	26	31	31
	Length, cm	12–14	12–14	12–13	11–13	9–12	15–16
Alburnus alburnus (Linnaeus, 1758) Common bleak (Cyprinidae)	Specimens	-	7	6	-	4	7
	Age, years	-	3	3	-	3	3
	Weight, g	-	17	16	-	17	17
	Length, cm	-	10–11	9–10	-	11–13	10–12
Carassius gibelio (Bloch, 1782) Silver Prussian carp (Cyprinidae)	Specimens	-	-	-	5	-	5
	Age, years	-	-	-	3	-	3
	Weight, g	-	-	-	105	-	65
	Length, cm	-	-	-	12–20	-	14–17

Species	Section	BR1	BR2	BR3	A1	A2	K
Rhodeus amarus (Bloch, 1782) European bitterling (Cyprinidae)	Specimens	-	9	-	-	-	-
	Age, years	-	3	-	-	-	-
	Weight, g	-	8	-	-	-	-
	Length, cm	-	5–7	-	-	-	-
Perca fluviatilis Linnaeus, 1758 European perch (Percidae)	Specimens	-	-	-	32	7	7
	Age, years	-	-	-	3	3	3
	Weight, g	-	-	-	42	45	40
	Length, cm	-	-	-	12–15	13–15	13–14
Gymnocephalus cernua (Linnaeus, 1758) Eurasian ruffe (Percidae)	Specimens	-	-	-	19	-	-
	Age, years	-	-	-	3	-	-
	Weight, g	-	-	-	24	-	-
	Length, cm	-	-	-	8–12	-	-
Lepomis gibbosus (Linnaeus, 1758) Pumpkinseed sunfish (Centrarchidae)	Specimens	-	-	-	7	5	-
	Age, years	-	-	-	3	3	-
	Weight, g	-	-	-	21	20	-
	Length, cm	-	-	-	7–11	8–10	-
Pelophylax ridibundus (Pallas, 1771) Marsh frog (Amphibia: Ranidae)	Number of specimens	2	-	1	2	2	-
Potamon ibericum (Bieberstein, 1809) Iberian crab (Malacostraca: Potamonidae)	Number of specimens	3	2	2	1	1	-
Coleoptera (Dytiscidae) Diving beetle	Number of specimens	1	-	-	-	-	-

The predominance of fish prey is normal and had been shown in the literature and sometimes exceeds more than 80 % of the otters' diet (Erlinge 1968, Webb 1975, Harna 1993, Geidezis 1996, Ruiz-Olmo and Palazon 1997, Taastrøm and Jacobsen 1999, Lanszki and Molnar 2003, Georgiev 2004, Reid et al. 2013, Juhász et al. 2014). Sidorovich (1995) divides water basins in terms of the percentage of fish in the otter menu. In the large and medium-sized rivers and lakes the fish represents on average 70 % of its dietary spectrum. In the small rivers it decreases to 50 %. In fish breeding ponds and micro dams designed for intensive fish farming it is averaging 73 % (sometimes up to 93 %) and in low-water rivers and drainage channels it is 38 %.

However, otters often use other groups of animals as secondary prey or even as their main food (Kruuk 1995, Adrian and Delibes 1987, Brzeziński et al. 1993, Geidezis 1996, Georgiev 2004, Lanszki et al. 2006, Miranda et al. 2008, Remonti et al. 2008, Poledníková et al. 2013, Juhász et al. 2014, Roos et al. 2015, Krawczyk et al. 2016, etc.). These include aquatic insects, reptiles, amphibians, birds, small mammals, crustaceans. It is known that

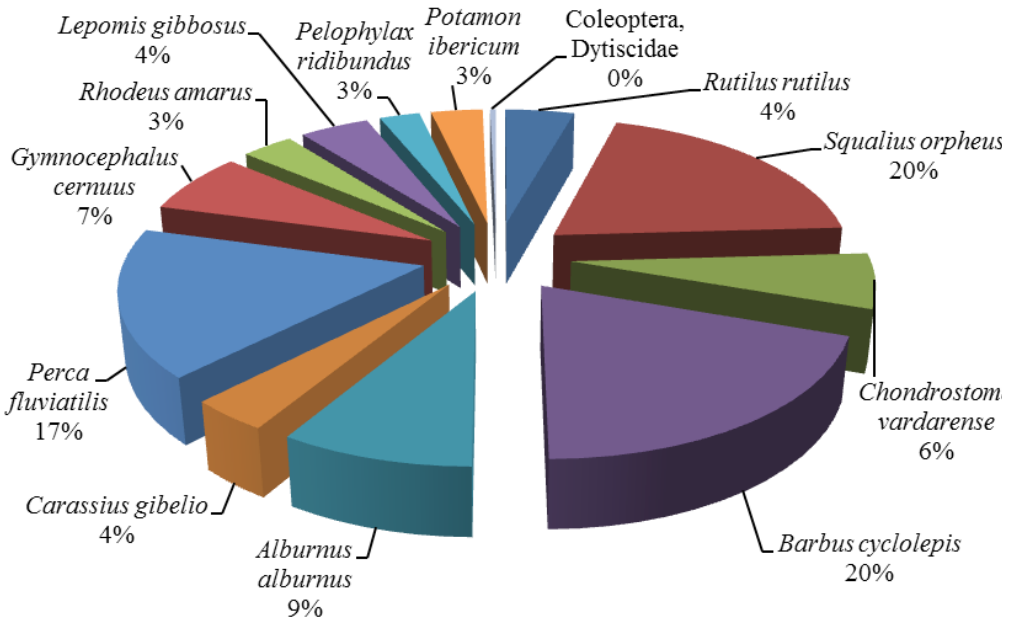

Fig. 2. Composition of the otter diet (as number of prey individuals in the spraints).

the otter can act as a highly specialised piscivorous predator in temperate freshwater ecosystems, while Mediterranean otters are more generalist predators, relying less on fish, and more on aquatic invertebrates and reptiles (Adrian and Delibes 1987, Clavero et al. 2003). There are also seasonal variations in otter diet (Adrian and Delibes 1987, Brzeziński et al. 1993, Geidezis 1996, Georgiev 2004, Miranda et al. 2008, Smiroldo et al. 2009). Fish consumption might decrease during winter, while the importance of alternative prey taxa increases (Juhász et al. 2014) or, on contrary, the share of the fish might be grater in the cold seasons when other food is hard to obtain (Georgiev 2004).

The data analysis from the different sampling transects demonstrated some particular features resulting mainly from the location of the station, water flow in the water body and the degree of anthropogenic influence.

The three sections located on Byala Reka River are very identical in terms of environment and naturalness, and any differences might be only resulting from the specific characteristics related to the biological and ecological requirements of the fishes or the features in terrain structure and river body. The analysis of otters' spraints collected along Byala Reka River showed the permanent and greatest percentage presence in all three transects of chub (34 % on average). In all three transects were found also barbel and Iberian crab, but they had a slightly lesser percentage presence, respectively – an average of 24 % and 6 %. In two of the sections we established bleak (an average of 22 %) and Marsh frog (an average of 5 %), and in only one of them – nase and bitterling. In all three sections the main part of the pray (by number of specimens) was almost thoroughly (over 75 %) formed by the three dominant spe-

cies in the river (chub, barbel and bleak). A similar significance was also found in relation to the distribution of relative biomass of the species in otters' menu. Size of the fishes (TL) ranged from 5 to 16 cm for the different species, and the weight – from 8 to 70 g. The specimens with age 3 years dominated and single individuals were 2-year-old.

The absence of invasive fish species in all three investigated sections is probably originating from the lack of human interventions and the relative remoteness of the area from anthropogenically affected stretches of the riverine system. The occurrence of bitterling in the third section located in the lower river stream was logical, given the silt deposit on the bottom, which is a necessary component for the existence of river mussels – a breeding substrate for this fish.

An interesting finding from the analysis of the sample from stretch BR1 is the fact that in the menu we found an insect from order Coleoptera, family Dytiscidae. Although rare, information for established insects in otters' diet is present in literature (Adrian and Delibes 1987, Sidorovich 1995, Georgiev 2004, Juhász et al. 2014), and in some cases the share of Dytiscidae might reach up to 9 % of the biomass taken by otters in spring and summer (Brzeziński et al. 1993).

The feeding with crabs was noted in other studies, as their rate could constitute a significant share and even dominate in the diet (e.g. Adrian and Delibes 1987, Chanin 2003a, Chanin 2003b, Georgiev 2004, Poledníková et al. 2013). In Bulgaria, Iberian crab is the most common species found so far in otter's diet (Georgiev 2004, Georgiev 2006, Georgiev and Stoycheva 2006a). It is also proved that amphibians, namely frogs, may consist up to 49 % of it (Poledníková et al. 2013).

The analysis of the spraints collected from the stretches of the rivers of Arda and Krumovitsa showed that the highest average presence in all three sections had the perch (22 %). In the first section (A1) it occupied 37 % of otter's food. Perhaps this was due to the higher stocks of this species in standing waters, in our case Ivailovgrad Dam. The perch is usually eaten more frequently by otters in pond areas (Geidezis 1996, Juhász et al. 2014). In all transects were presented the barbel (20 %), chub (13 %) and roach (7 %).

The greatest was the diversity of species in the first section (A1) – 10 species, as in addition to the above mentioned we also found nase, silver carp, ruffe, sunfish, marsh frog, Iberian crab. This variety is probably resulting from section size (it is the biggest of all) and the various conditions – the presence of a river and a large dam (Ivailovgrad Dam). The results of the analysis demonstrated increased presence (with around 75 %) of the invasive species, both as number of specimens and relative biomass significance in the otter diet as well.

Data from section A2 included a total of 8 food components – 6 fish species, marsh frog and Iberian crab. In species composition of fish-preys, this section is distinguished by the absence of two invasive species – silver carp and ruffe, and by the presence of bleak. By number of specimens in the diet predominated the typical river species – chub, barbel and bleak, and the invasive perch and sunfish had a secondary importance. Similar relative biomass ratios in the otter diet had the chub, barbel and perch. In this sector the river is relatively preserved, but through the direct link with Kardzhali Dam, invasive species such as perch, sunfish and roach penetrate in it, and they probably trophically, spatially and generatively com-

pete with the autochthonic ichtyocoenose.

The results of the dietary analysis in the section near the mouth of the river Krumovitsa (K) differed significantly from those in Arda River, due to the relative naturalness of the habitat and absence of human interventions. The presence of two invasive species (perch and silver carp) was probably due to the connection of the river with the affected section of Arda River below the wall of Studen Kladenets Dam. Qualitatively and quantitatively the diet of the otter at maximum approached the natural for the area food resources.

The established preys of the otters were characterised by different frequency in the studied areas. Only two species (barbel and chub) have been found in all transects. It was interesting that, although they made a small proportion in otter diet, marsh frog and Iberian crab were present in 5 out of the 6 analyzed plots. It is entirely possible that they occupy a significant part of the otter menu in the Eastern Rhodopes, especially in the winter (in overwintering clusters of amphibians, etc.) (observed by Juhász et al. 2014), but due to the short collection period and the only few sections that could not be established. The availability of alternative prey might decrease the chance of disturbing fish species during hibernation, which is of great importance especially for fish farming.

The length of fishes' body (TL) varied within the individual sections and species – from 7 to 20 cm, and the weight was in the range 20–100 g. Figure 3 shows the minimum, maximum and average body lengths. The age of the majority of the fishes caught by the otters was 3 years (rarely 2 and 4 years). These data about the otters' feeding largely overlap with the data published by other authors (Peshev et al. 2004).

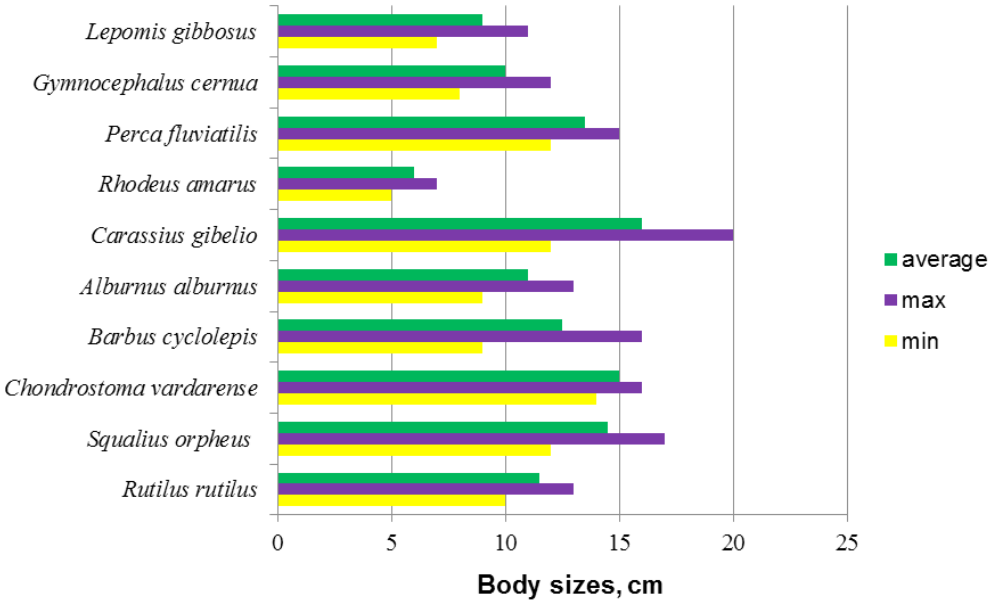

Fig. 3. Body size of the fishes in otters' diet.

In our study the most common sizes of the fish preys were from 8–10 to 12–14 cm, regardless of the species belonging. Most of them had a weight of 30–40 to 80–90 g. Larger by size and mass were relatively few individuals of nase, silver carp and chub. Less weight was found in bitterling and bleak, but their dimensions were close to the typical for the otter preys. It is known that the Eurasian otter is capable of taking fish as large as 9 kg (Chanin 2003a), however, many studies in Europe have revealed that the fishes consumed by the otters are relatively small with a median length of 13 cm (Kruuk 1995, Roos et al. 2015), which is in accordance with our results vice versa. In Denmark otters' showed a tendency for selecting individuals between 9–21 cm (Taastrøm and Jacobsen 1999). In Poland, 35 % of the fishes in otters spraints were within the same limits (10–15 cm) and 50 % were even smaller (7–10 cm) (Brzeziński et al. 1993). Larger fishes were preferred in artificial wetlands in Hungary (Juhász et al. 2014).

The ratio of various fish species in the otter diet is presented in Figure 4. The main fish species in the studied area were the chub, barbel and nase, and additional were the bleak, perch, roach, silver carp, bitterling, sunfish, ruffe. The perch and roach were among the most common prey in Czech Republic representing respectively up to 49 % and up to 31 % of the diet (Poledníková et al. 2013).

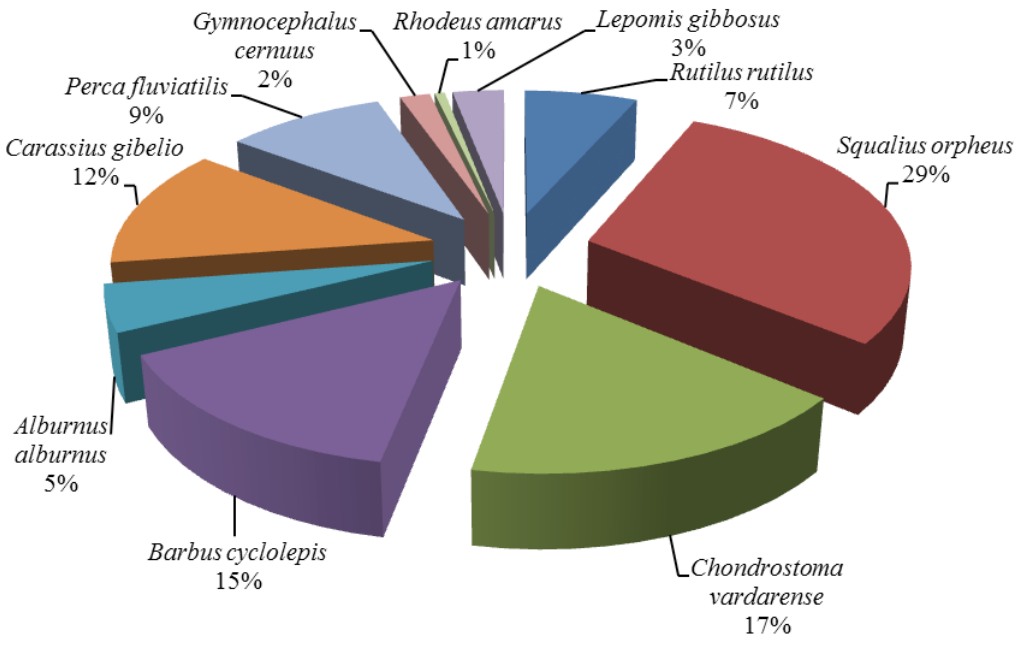

Fig. 4. Percentage partition of the fishes in otter's diet in the Eastern Rhodope Mts., calculated according to their weight, g.

Large fish species were mainly 3-year-old and rarely 4-year-old. Small fishes were around 7 cm long and weighing up to 20 g, and the maximum dimensions of the fishes were 20 cm in length and 100–150 g in weight.

The otter is an important factor in the natural selection of fish populations, destroying mostly ill, physiologically weak and lagging in development preys. Accounting the weight of this predator (6–8 kg for females and 8 to 10 kg for males), the average weight is about 8 kg. For the maintenance of the normal vital functions during the year the otter needs to consume daily about 10 % of its own weight, or 10 fishes weighing 80 g or 20 fishes weighing 40 g (an average of 15 fishes) (Kruuk and Carss 1996). This hypothesis completely eliminates the portion of other food objects, which for the large rivers normally are 30 %, and for the small and poor in fish – up to 50 % and even more.

For maximum accuracy in assessing the status and capacity of a water basin in relation to the otter density, it is necessary in parallel with the analysis of the diet to conduct a specialized study of the ichthyofauna and ichthyocoenose, accounting the exact realization of the species in accordance with the available food supply, and its main population parameters – density, age and sex structure. For defining and achieving optimal accuracy on the capacity of given habitat for otter's density it is necessary to examine in detail gender and age structure of the animals, and to evaluate afterwards the distribution along the concrete coastal transect.

In ideal conditions for river sections of medium large rivers, such as in this particular area, the individual stretch varies depending on the trophic capacity on average from 2 to 6 km for an adult male otter, which most often overlaps with two females. If we assume that, on average, the female raises 3 cubs, then for the feeding of these 9 individuals it will be needed daily the following maximum quantity of fish: 1.5 kg for the male, 2 kg for the females (1 kg each), and 0.5 kg for each cub. It makes a total of about 6.5–7 kg per day, about 210 kg per month and approximately 2500 kg per year, if we consider that juveniles stay with their mothers during the winter period. Averaging the data of the hypothetical model allows us to consider that normally the otters eat about 500 kg per kilometre from the medium-size river valley or an average of 10,000 fishes with medium size 15 cm and weight of 50 grams. Calculated per hectare of the river surface this densities are respectively 20/500 m = 10,000 m^2 for Arda River and 10/1000 m = 10,000 m^2 for the rivers of Krumovitsa and Byala Reka.

The research of the fish stocks in Arda River and other rivers of the Aegean catchment area showed stocks of an average 10,000 individuals with average fish biomass of 150–350 kg/ha (Dikov et al. 1994). According to this, for the normal distribution of the otter individuals is needed three times longer feeding stretch in Arda River, which means that for the combination of one male and two females with three cubs a stretch of around 12–15 km will be needed.

The rivers of Krumovitsa and Byala Reka are characterized with relative unaffected and natural coastal habitats. Therefore, in spite of their twice smaller size, it could be considered that their fish stocks per hectare are not smaller than those of Arda River and their potentials are not insufficient for the otter, and it is also very likely that with expected supply of 50,000–100,000 individuals and biomass from 300 to 500 kg per hectare, a stretch with length of about 5 km would be fully adequate for the maintenance of an optimal otter density. Such biotic parameters of relatively small but well preserved rivers in Bulgaria were measured repeatedly (Dikov et al. 1994).

Differences in the prevailing prey species are primarily originating from the differences in the structure of water basins and the conditions of hunting. In the otter's diet usually the benthic, but mostly inhabiting the coastal areas, preys predominate (e.g. Kruuk and Moorhouse 1990). This fact was confirmed by the absence of preys like the sheat-fish and carp, as well as the increased percentage of species like the perch, barbel and chub. According to Juhász et al. (2014) common carp predation is present more frequently in winter and spring.

The study of Krawczyk et al. (2016) demonstrated that the plasticity of the feeding behaviour might be explained by the various habitats occupied by otters, and habitat differences reflected in otter's diets might have importance for the maintenance and conservation of local populations of this species.

However, different studies seem to show that otters do not always feed on the most abundant prey (fish) but are selective. Probably behaviour (flight behaviour, catchability), distribution (pond or river) and/or even nutrient value of the potential prey influences the otter's choice (Geidezis 1996). According to Miranda et al. (2008) non-native fish species occurred relatively rarely or not at all in otter spraints. The same was established also for introduced crustaceans (Beja 1996). Therefore, the maintenance of indigenous prey should be considered a major issue in conservation strategies, even in areas with abundant populations of introduced animals.

Another important issue is the destruction of natural habitats (via pollution, water acidification, canalization of rivers, removal of bank side vegetation, dam construction, draining of wetlands, aquaculture activities and associated anthropogenic impacts on aquatic systems) though seriously affecting the otter populations (Reuther and Hilton-Taylor 2004, Roos et al. 2015, Pandakov et al. 2017).

Furthermore, most of the people in the surveyed area perceive the otter entirely as a hunting object. This undoubtedly means that there is a poaching pressure over the studied species, which even thou currently not severely affecting the population, in the future might manifest. Another alarming fact is the conflict between the otter and fish poachers (Georgiev 2007). Human-wildlife conflicts often arise between humans and large protected vertebrates when they compete for the same biological resources or when wildlife cause damage, especially in case of farmed resources (Kloskowski 1999, Vaclavikova et al. 2011). In many cases the otter eats fish straight from the nets of the poachers seriously damaging them. At the same time, there are data on drowned otters (Georgiev 2007), as a result of entanglement in poachers' fishing nets (Studen Kladenets Dam).

Conclusion

As result of this study we analysed and evaluated the dietary preferences of the otters on the territory of the Eastern Rhodope Mts., as well as their importance to the hydrobionts in a concrete habitat. We investigated the feeding plasticity of the species, depending on the habitat type and available food base. For complete elucidation of otters' dietary composition, however, additional specialized research is needed.

Otter in the region is trophically dependent on the specific characteristics of the feeding water basins. The most common preys are fishes inhabiting coastal

areas of the standing waters and relatively shallow stretches of the rivers. Fish preys are with medium body size 10–12 cm and weight 80–90 g.

The main fish species in the studied area are chub, barbel and nase, and additional are bleak, perch, roach, silver carp, bitterling, sunfish and ruffe. Very often in the otter diet are established frogs and crabs that are particularly common in the basins and easy to catch preys. The analysis of the relative share in the diet biomass showed a strong dependence on the density of the prevailing size-weight prey group and relatively weak preference of particular preyed fish species, either natural or invasive.

Deterioration and destroying of natural habitats, reduction of the food base, disturbance during the breeding season of the species and poaching are serious threats to the otter in the Eastern Rhodopes. For their overcoming are needed multitude efforts and resources, but as a first and essential condition for starting of the conservation activities it is necessary an Action plan for conservation of the otter in Bulgaria to be developed and approved. It will represent the beginning of the real conservation measures for this species in the country.

Studies of the diet of the otter by spraints and other food remnants can be successfully used for mapping and monitoring of the ichthyofauna and ichthyocoenoses in different sections of water basins, for assessment of the current state and for prognosis about the development of otter populations in a given area as well. Such investigations contribute to the recording, mapping and paspotisation of the ichthyofauna and ichthyocoenoses as a component of the otter's diet, and such data may be used for the purposes of the conservational monitoring.

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