

FEEDING HABITS OF THE EURASIAN OTTERS *LUTRA LUTRA*, LIVING IN PUTNA VRANCEA NATURAL PARK IN THE EASTERN CARPATHIANS, ROMANIA

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ABSTRACT: The Eurasian otter (*Lutra lutra*) has been described as piscivorous in Romania, but our recent studies suggested that the otter may be better defined as an opportunistic predator, with its feeding behaviour being dependent on the availability of prey. Otter is recognised as one of the top predators in freshwater systems, and thus has the potential to play an important role in the functioning of these ecosystems.

Between December 2012 and September 2013, the diet of the otter, was identified by collecting and examining n 56 spraints (faeces) from 36 sites (different habitats, streams and rivers), from several river catchments throughout Putna Vrancea Natural Park in the Eastern Carpathians.

In most of the spraints, fish was the main prey consumed, 31%, followed closely by amphibians with 24%, insects 21%, mammals 16% and other groups in a small amount: 3% gastropoda, 3% plantae and 2% reptilia.

Keywords: diet, mustelidae, otter, Carpathian Mountains, freshwater habitats.

INTRODUCTION

The Eurasian otter, (*Lutra lutra*, Linnaeus, 1758) is a semi-aquatic carnivore belonging to the Mustelidae family. Otter is listed in Appendix I of CITES, Appendix II of the Bern Convention and Annexes II and IV of the Habitats Directive. The otter is classified as 'Near Threatened' by the IUCN and considered 'vulnerable' by the Romanian Vertebrate Red Book (Botnariuc & Tatole 2005).

In many areas of Europe and Asia, otters remain a species of conservation concern following widespread population declines during the 20th century (Ruiz-Olmo et al. 2008). The otter is one of only a few European carnivores that has developed the ability to actively forage both in water and on land (Oliveira et al. 2008).

Having knowledge of what individuals eat is one of the most important aspects of animal ecology. This is especially true for otters (*Lutra lutra*), the new data and research has shown a strong relationship between the availability of food resources, and the distribution and survival of the species (Kruuk et al. 1987). The information about the otter diet is clearly important for otter conservation.

The Eurasian otter can live in a wide variety of wetland habitats in Europe (Conroy & Chanin 2002) if they provide sufficient food resources (Kruuk H. & Moorhouse A. 1991) and if the riverbank vegetation gives sufficient cover.

The most important otter habitats in Putna Vrancea Natural Park are the streams and the rivers covered by waterside vegetation like shrubs and alder riparian forest where fish is generally available throughout the year. The habitats of the Natural Park provide a wide diversity of prey species used by otters, which are included in the following main groups: pisces, amphibia, mammalia, reptilia, gastropoda, insecta and plantae. Opportunistic

behavior of the otter, in terms of diet, is well defined by this study.

In Romania, otter diet composition is poorly known, but also in the European level is little known about the diet of the otters in streams and small rivers from the mountain areas. (Jedrzejewska et al. 2001, Clavero et al. 2003).

Some information about otter diet in Romania we have from Ionescu & Ionescu 1994, who analysed the stomach contents of 14 Eurasian otters, the results showed that the percentage of otter diet is 78 % fish, 8 % frogs, 6 % mammals and 8 % invertebrates (crustaceans, molluscs, insects) describing otter as piscivorous.

The aim of this study is the identification of the feeding habits and the trophic resources, on which depends the survival of the otter species from Putna Vrancea Natural Park and Eastern Carpathian Mountains.

MATERIALS AND METHODS

Study area

The study was conducted on the rivers and streams belonging to 8 basins from Putna Vrancea Natural Park: Lepșa, Lepșuleț, Putna, Ostog, Mărul, Strâmba, Tișița, Tișița Mică.

The park is located in south-eastern Romania, north-east of Vrancea County (Long. 26.503436 Lat.45.921461) and covers an area of 382.13 km², with altitude ranging from 435 m a.s.l. in the valley of the Putna River to over 1785 m a.s.l. in Goru Peak.

Putna River springs and collects all the streams in the park, except the south, and forms a narrow west - east oriented valley in the central part of the natural park. Most of the flow takes place at the end of the spring (44%) and early summer (30%), when there is a substantial increase in the fluid flow, resulting in significant floods.

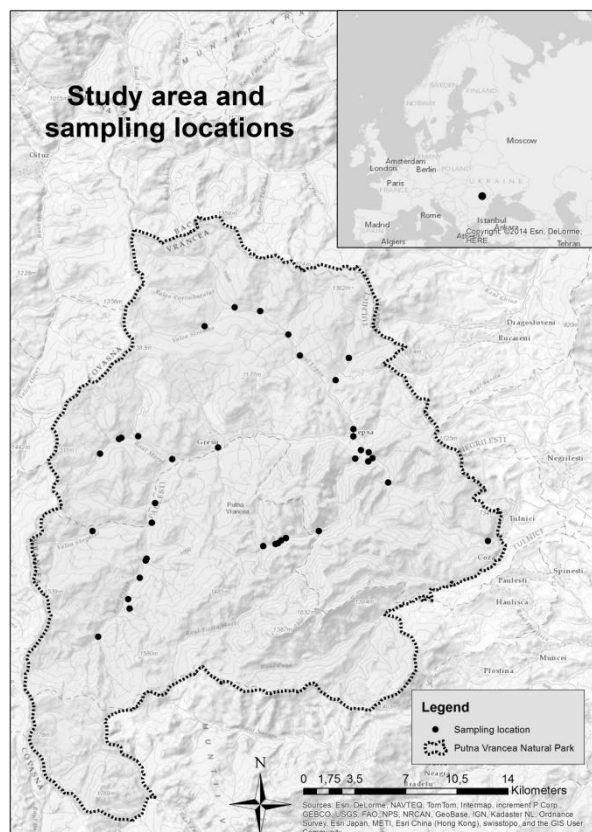


Fig. 1 The map of the study area and the sampling locations from Putna Vrancea Natural Park

The annual average flow of the river Putna measured at hydrometric station Lepşa, at 21 km from its sources, is 1,83 m³/s and in Tulnici, when it leaves the park area, is 4,58 m³/s.

Riparian woods consist mainly of alder (*Alnus glutinosa*, *Alnus incana*) and willow (*Salix spp.*). In the Putna Vrancea Natural Park live a stable and relatively abundant otter population.

Spraint collection and analysis

A number of n 56 otter spraints were collected from December 2012 to September 2013 from 36 different sites, evenly distributed over the surface of the park, in order to have a better distribution of the data.

Only the suitable spraints were collected for their analysis, generally the larger and those that were intact or wet, being avoided the fragmented ones, in which most of the content was wasted.

Otters usually deposit their spraints on prominent rocks located on the river bank or in the stream. Spraints were collected carefully in order not to destroy the fragile remains of vertebrae and placed in paper envelopes or paper bags well ventilated. Most of the spraints were picked up by hand, only old and dehydrated spraints which were likely to crumble were picked up with the help of a spoon. The spraints which were stuck to rocks or roots were removed with the help of a penknife.

On envelopes were noted following information: date, time, name of the observer, GPS geographic coordinates, river or stream name, site code (where excrement was found in one of the sites under monitoring or transects)

and estimated spraint age, based on its nature (dry fragmented, dry intact, wet).

The spraints were collected in two different periods of the year, in order to notice variations in the trophic resource utilization by season, so during the period winter – spring (December 2012 – May 2013), 27 spraints were collected and 29 spraints, during the period of summer (June 2013 – September 2013), in order to make a comparative analysis of otter diet.

Before the analysis, samples were prepared one by one. Spraints were individually soaked in a metal container containing 1/3 of water and 2/3 of detergent for 1-3 days to a week depending on the sample, swirling occasionally.

In this study, we also added, additional detergent for faeces that have been very large and contain a high amount of mucus. Liquid detergent proved to be much easier to use and was more effective in cleaning the spraint content.

Samples were washed by tipping the contents of the cup into a 0.5 mm fine mesh sieve. The contents of the sieve were then washed further to remove any remaining mucus and dirt from the particles. The spraint particles were then carefully removed from the sieve and placed in a white plastic tray for drying and sorting.

Using different size forceps and needles, any bone fragments were identified, picked out and sorted into groups: Amphibia, Pisces, Mammalia, Insecta, Gastropoda, Reptilia and Plantae. The largest vertebra and exoskeletons could be identified with the naked eye, but for the smallest have been used a magnifier and a microscope (10 X).

Each spraint has been assigned an identification code and were recorded in a register, all details of each spraint. The number and percentage of species that were present in the spraint was recorded in the register and ready for statistical analysis.

The percentage of occurrence (PO %) of each prey group was plotted per each spraint and secondly per all spraints.

The relative frequency of occurrence per prey item was also calculated (Conroy et. al. 2005), by dividing the total occurrence of a particular species by the total occurrence of all prey items by expressing it as the relative frequency of occurrence (RFO%) calculated as:

$$RFO\% = \frac{\text{Number of occurrences of a prey group} \times 100}{\text{Sum of occurrences of all prey groups}}$$

After being analyzed, feces were dried and stored in a collection in plastic tubes which has been assigned a code and date.

RESULTS

Relative frequency of occurrence in spraints of various groups of prey species (RFO%)

The analysis of 56 samples gave us valuable information about the feeding habits and trophic resource consumed by otters in Putna Vrancea Natural Park. We note that the most important frequency in the spraints, have fish, from a total of 56 spraints, 53 of them contained the remains of fish.

Tab. 1
Eurasian otter diet expressed as relative frequency of occurrence in all spraints (RFO%)

Prey group	RFO %
Mammalia	16 %
Reptilia	2 %
Amphibia	24 %
Pisces	31 %
Gastropoda	3 %
Insecta	21 %
Plantae	3 %

Frequency of occurrence in spraints was calculated for the 56 samples, and have reached the following results: 31% of prey species consumed by otters were fish, 24% amphibians, 21% insects 16% mammals, 3% snails , 3% plants and 2% reptiles. Most of the species that have been identified to the spraints were species that can be found in riparian habitats occupied also by the otter.

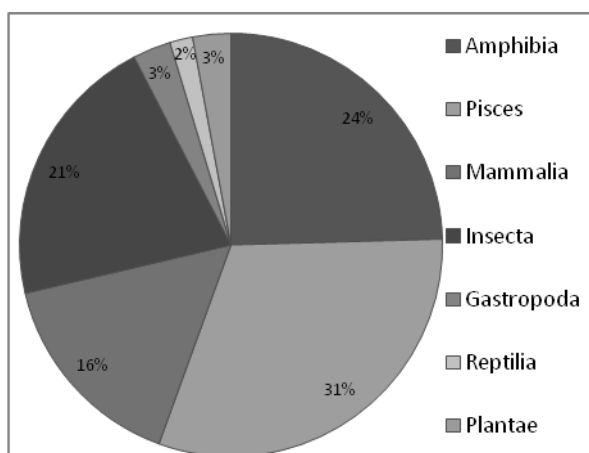


Fig. 2 Relative frequency of occurrence (RFO%) - Total spraints analyzed

Following the separate analysis of the samples collected during the two periods of study: first study winter – spring and second study summer, we noticed some differences in the use of trophic resources by the otters in the Natural Park.

In the first study were analyzed 27 spraints and in the second one, we analyzed 29 spraints, being approximately the same quantities.

In both study periods, 31 % of all appearances was the fish, changes were identified in amphibians consumption, in winter-spring period occurring in 26%, while in the summer, amphibians consumption decreased, they were present in 23%, fact which is explained by the ease that otters can plunder amphibian breeding sites during the period in which they oviposition in spring.

Tab. 2
Seasonal variability of otter diet expressed as relative frequency of occurrence in all spraints (RFO %)

Prey group	RFO %	RFO %
	winter – spring	summer
Mammalia	18 %	13 %
Reptilia	2 %	1 %
Amphibia	26 %	23 %
Pisces	31 %	31 %
Gastropoda	3 %	2 %
Insecta	20 %	24 %
Plantae	0 %	6 %

A change appeared in the the consumption of insects, the relative frequency of occurrence in winter-spring period is 20%, rising to 24% in summer, when there is a higher frequency of invertebrates in the environment occupied by otters. In the winter-spring period, mammals had a higher frequency of occurrence, 18% of all species groups consumed by otters, mammals consumption decreased in summer to 13%.

Reptiles and gastropods were not an interest to the otters from Putna Vrancea Natural Park, they had a low occurrence frequency in the analyzed spraints, being consumed in a low rate in both study periods (1-3%).

We noticed a difference from the winter-spring period, during the summer it is notable a high frequency of occurrence in plants, they appeared at the rate of 6% compared to the spring – winter time, when they were not identified as part of the otter diet.

Percentage of occurrence (PO%) of prey groups in total spraint analysis

The percentage of occurrence (PO%) of the n 56 spraints was calculated for each of the seven prey groups which were identified in the otter spraints, which were collected from Putna Vrancea Natural Park.

Tab. 3
Eurasian otter diet expressed as Percentage of occurrence (PO%) of prey groups in total spraint analysis

Prey group	PO %
Mammalia	14.6 %
Reptilia	3.1 %
Amphibia	22.3 %
Pisces	56.4 %
Gastropoda	0.1 %
Insecta	3.3 %
Plantae	0.2 %

From all the spraints analyzed, fish remains were most frequent and most numerous, 56.4% of the trophic resource used by otter was fish, followed by amphibians that were consumed at a rate of 22.3%, they came as a food complement to the fish resources, the fish remains were most frequent and most numerous. Mammals were present in otter diet at a rate of 14.6%, insects and reptiles were consumed occasionally, representing a trophic resource used by otter only in a 3%, gastropods were eaten occasionally being present in the analyzed spraints

in 0.1% and plants were underrepresented in consumption by otters, only in 0.2%.

An interesting situation appear from the analysis of the two graphs figure 3 and figure 4, with the percentages on each of the 7 classes which were in analysis, in the two periods for which the data were collected in the field.

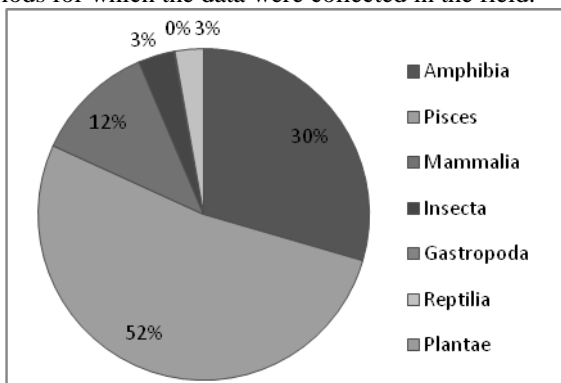


Fig. 3 The percentage of occurrence (PO%) of prey species classes - Winter - spring study

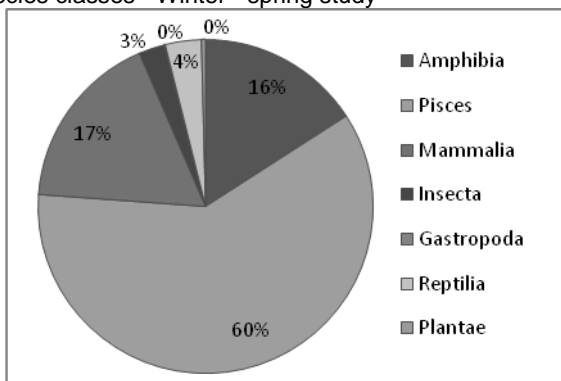


Fig. 4 The percentage of occurrence (PO%) of prey species classes - Summer study

We noticed that during winter-spring period, when first study was carried out, fish consumption was reduced by 8% as compared to the second period when it was 60%. It seems natural that in winter-spring period, the consumption to be slightly lower due to the harsh conditions of fish catching into the icy waters and in spring high waters that occur once with the snow melting.

Amphibians constituted 30% of the trophic resource consumed by otters in winter-spring, while during the summer, when it was realized the second study, amphibians were consumed only at a rate of 16%. This high difference of 14% can be explained by the fact that during the spring, we found that there is the biggest consumption of amphibians, due to their meeting at breeding sites where they oviposition. These breeding sites for amphibians are often plundered by otters.

Mammals have come as a complement to trophic resource used by otters of Putna Vrancea Natural Park, with 12% of the total in winter-spring period and 17% during the summer period, when the activity of the small mammals is more intense.

Reptiles did not have a high frequency in all the analyzed spraints but they had a high share, some of the excrements were made 100% of reptiles remains. The differences between the two study periods are minor in

the first period have been identified in 3% and in the second period in a percentage of 4%.

Insects although they had a high frequency of occurrence in the total number of analyzed excrements, they represented only 3% of all trophic resource used by the otter, being same percentage for both study periods.

Gastropods were present in a small percentage in otter diet, only 0.1% in the first study period and 0.05% in the second study period. These can be identified by shell remains found in spraints.

The plants have missed from otter diet in winter-spring but occurring at a rate of 0.4% during the summer, which can be explained by the fact that in summer we are in the middle of the vegetation season.

The percentage of occurrence (PO%) of occurrence of prey species classes in each of analyzed spraints

Percentage of prey species groups was calculated for each spraint, for both study periods. Could be noted that a high percentage of fish is present in most of excrements for the first period, unlike those in the second period of study.

Amphibians prevails in the consumption from first study period (winter - spring study) in contrast with the second (summer study).

Should be noted that in the first study period, in a single spraint could be identified a consumption of varied prey species, unlike the second study period, when the consumption of prey species consisted only of one or two classes of species, as you can see in the graphs from figure 5 and 6.

We notice that a high percentage of the spraints were composed 100% just from a class, most of the time were the classes: Pisces, followed by Amphibia, Reptilia and Mamalia.

An interesting example is the presence of snakes remains, only in one area of the Natural Park, snake was identified in two spraints only, which were collected at the confluence between Tişîţa and Putna river. The otter that lives here being the only one that eats reptiles, even if the fish resources here are in a high density.

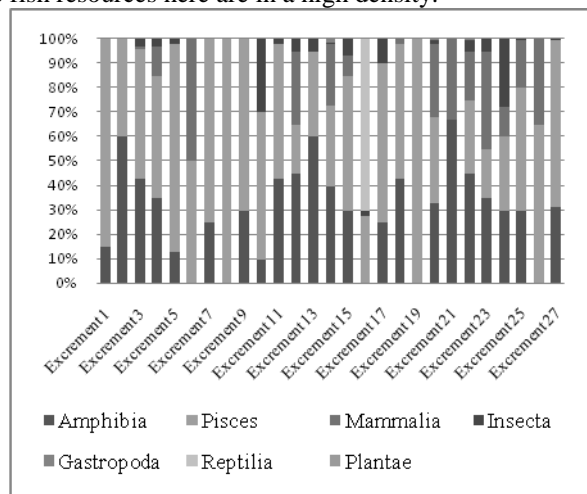


Fig. 5 The percentage (%) of prey species classes of each excrement analysis. Winter - spring study - 27 samples

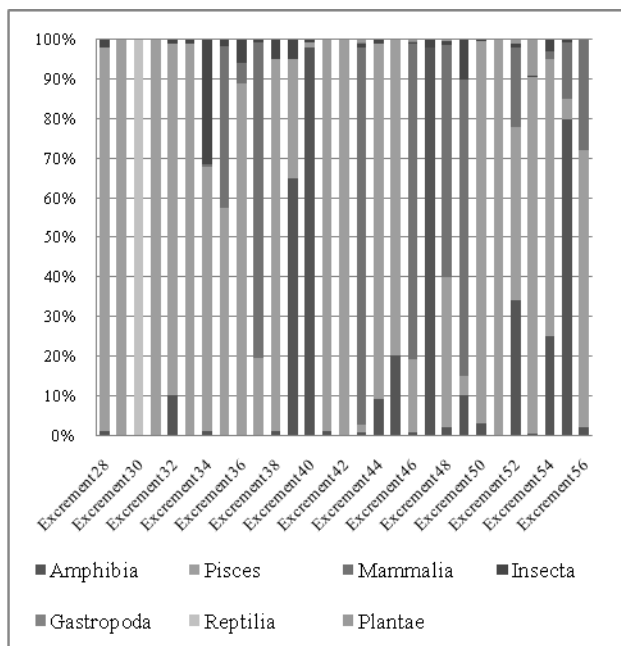


Fig. 6 The percentage (%) of prey species classes of each excrement analysis. Summer study - 29 samples

DISCUSSION

The feeding habits of the otters living in Putna Vrancea Natural Park from Eastern Carpathians, were largely similar with the diet composition of the eurasian otters living in areas with a temperate climate. Otters were preying primarily on fish and occasionally amphibians, which were the main food for otters. (Jedrzejewska et al. 2001, Clavero et al. 2003).

The consumption ratio of fish as primary food resource showed a characteristic seasonal pattern with an increasing trend from winter – spring period to summer, although differences were found between different areas, where samples were collected. The seasonal changes may be caused by fluctuation between seasons in the fish availability and the harsher hunting conditions for otters during the winter and spring.

Fish were the otter's main food preference, representing almost 56.4 % of the consumed preys among otters inhabiting freshwater habitats from Putna Vrancea Natural Park (Table 3). The remaining prey categories can be considered as secondary food resources. Predation upon amphibians, mammals, reptiles and invertebrates came as a supplement in the otter diet.

On the streams and rivers from this study, amphibians represented a high supplementary food consumption resource which was found in a high percent during the late winter and spring having the same results like other authors that noted higher amphibian consumption in late winter and spring (Weber 1990) or higher amphibian consumption in spring (Harna 1993).

The main otter habitats from other European regions, such as ponds and rivers (Kranz 2000, Jedrzejewska et al. 2001, Remonti et al. 2008), the supplementary foods resources are mainly important in winter and spring, usually in relation to fluctuations in fish supply. Higher

spring and summer consumption of supplementary foods (especially amphibians), may also be in relation to changes in the relative abundance of possible prey, e.g. early spring is the oviposition period of amphibians and they become easier to catch. In this study amphibians were the most important supplementary food of otters.

The amphibians might be seasonally accessible not only in the riparian habitats close to the rivers and streams, but also on the adjacent habitats such as small temporary ponds and broadleaf forest.

The otter spraints were found mainly under the bridges or close to the bridges, and over 1000 m.a.s.l no otter spraint could be identified along the freshwaters valleys from Putna Vrancea Natural Park. The lack of spraints presence above 1000 m.a.s.l is explained by the scarce trophic resources that could be consumed by the eurasian otters over this altitude.

Probably the methods used for this study, have not provided exact results on otter diet, but have provided a more accurate image of otter diet in the Eastern Carpathians.

Based on critical analyses (Carss & Parkinson, 1996; Jacobsen & Hansen, 1996) that have shown that RFO is not the best method to assess otter diet, leading to overestimation of medium size prey items and underestimation of the smaller and bigger ones.

However, Jacobsen & Hansen (1996) compared several methods and found that similarity of RFO% results with those of more accurate methods was between 80% and 90% (Renkonens Index of Similarity). Thus, being the most frequent method used in literature worldwide I considered the RFO% and PO% an appropriate methodology to establish the feeding habits of the eurasian otters.

CONCLUSIONS

In conclusion, otters living in Putna Vrancea Natural Park took fish as their main food and amphibians as secondary food category. Fish prey mainly consisted of small-sized specimens. Otters being opportunistic predators and easily adaptable, can survive on short-term only with complementary food resources, such as: amphibians, mammals, reptiles, invertebrates, until fish availability increases once again.

The results of this study shows that the valleys of the streams and rivers from the Eastern Carpathians, located to an altitude below 1000 m.a.s.l, plays an important role for the survival of the otter population, at least as feeding places. As such, this results indicate that the whole watercourse is important for otter conservation, monitoring and management of the otter habitats should include also the small streams not only the main rivers.

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