Working towards transboundary conservation of Prespa region by common actions raised by PrespaNet partners

The PrespaNet partners MES, PPNEA and the SPP are carrying out studies on large mammals of the Prespa basin as part of the project "Strengthening NGO-led Conservation in the Transboundary Prespa Basin". The Transboundary Strategic Framework followed by the partners identified the need for reliable studies of large carnivores (bear, wolf and lynx) at transboundary level, in order to fill gaps in the knowledge of these species and to address the threat of illegal killing to which they are vulnerable. One of these studies focuses on the collection of brown bear scats for analysis of their dietary components, in order to provide insight into their movements and behaviour, as well as to provide samples for genetic analysis, in order to determine the population characteristics of the species for the basin. Scats were collected on all three sides of the basin by teams from the NGOs, together with park rangers, volunteers and members of the public.

Brown bear diet analyses

- **Overview**

A total of 553 scats have been analyzed from all three sides of Prespa. 120 of those were collected from the Albanian side of Prespa , 124 from the Macedonian side, and 309 from the Greek side.

The collecting period was split into seasons (spring, summer and autumn), with targets set to 30 scats per country for each season (plus 30 each in summer and autumn in the agricultural zone in Greece), with the exception of the autumn period where the target was increased to 70 per country in order to gather samples for genetic analysis. Samples were collected as follows:
65 scat samples in spring (15 Mar 2018-14 Jun, 2018 and 15 Mar 2019-14 Jun, 2019); 188 scat samples in summer (15 Jun 2018-14 Sep, 2018 and 15 Jun 2019-14 Sep, 2019) and 300 scat samples in autumn (15 Sep 2018-14 Dec, 2018 and 15 Sep 2019-14 Dec, 2019 (Tab. 1).

Country	Spring	Summer	Autumn
Albania	21	19	80
N. Macedonia	21	23	81
Greece	23	146	139
Total	**65**	**188**	**300**

Table 1. Total number of scats collected per season.

The scats were collected from 22 different habitats, giving insight into the habitat preference by the brown bear. The most preferred habitats were oak forests, mixed forests, agricultural lands with natural areas and abandoned agricultural lands (Fig. 1).

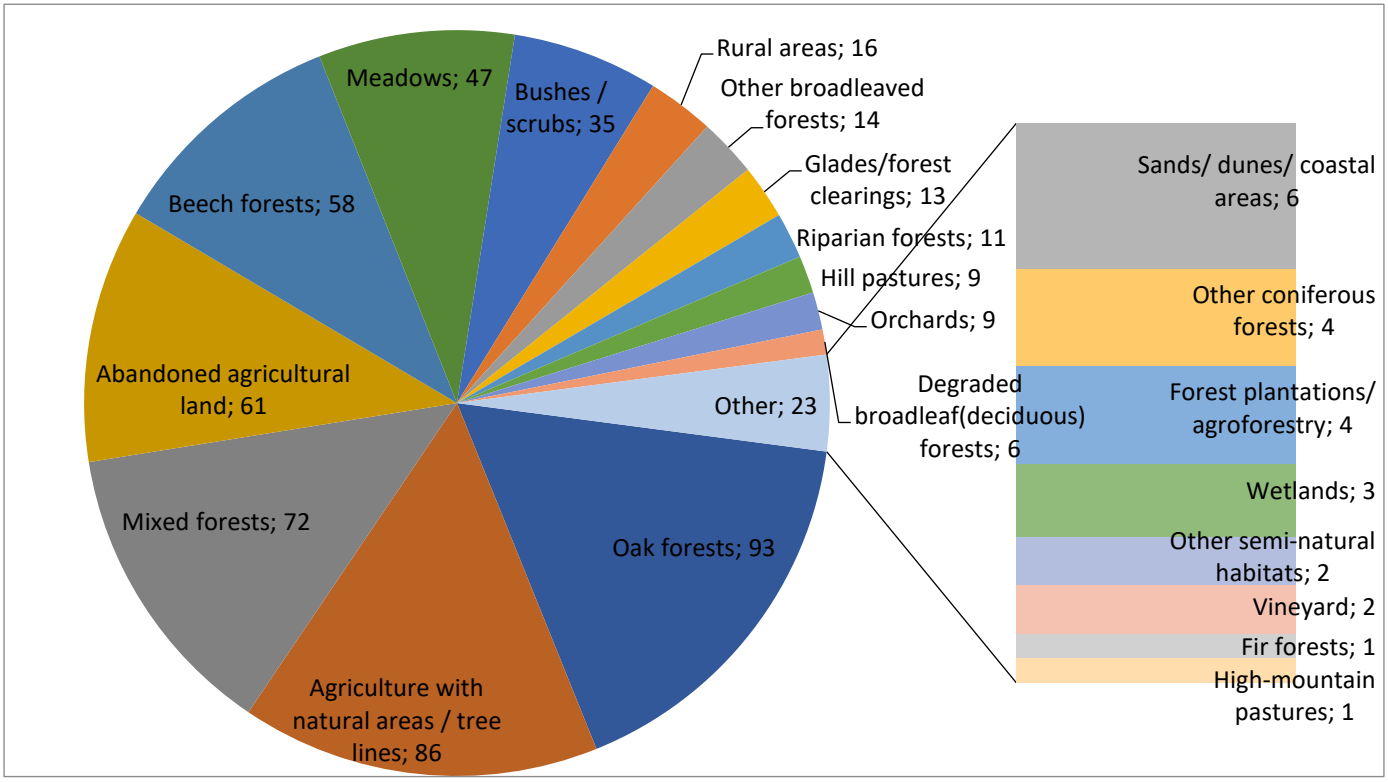

Figure 1. Number of samples found in different habitats

- **Methodology**

The fieldwork for collecting on the Macedonian side was carried out opportunistically in the first year (2018): no defined transects and dynamics of work. However, game wardens from the two national parks were contacted and trained in collecting scats. They were given sampling kits composed of tubes with alcohol, plastic bags with printed sheets containing the necessary information that needs to be filled. For the following year we opted for a more systematic approach. In that regard, 25 transects were proposed that covered the Macedonian side of Prespa (photo 1). The majority of transects were non-asphalt forest roads which were driven along by car, while a few transects were hiking trails that needed to be covered by foot. The team also sought to visit the area once in every 7 to 10 days. During the collecting period the team was offered help from game wardens and foresters from the two national parks (Pelister and Galichica). Furthermore, some of the scats were collected with the help of locals.

In Greece, an additional focus of this particular study was analysis of scats found in the agricultural zone, where increasing human-bear conflict has been seen in recent years. Sampling of bear scats was carried out using both fixed transects and opportunistic collection. Ten transects – dispersed throughout the Greek Prespa, including the agricultural and littoral zones – were driven along by car once per month during the agreed seasons for collection, and all bear scats detected along the route were collected. In addition, the wardens of the Management Body for the Prespa National Park, SPP staff and the SPP's volunteers were opportunistically collecting bear scats when out in the field for various unrelated purposes and delivering them to the SPP. Lastly, teams carrying out a related

camera-trapping study on large mammals, including brown bears, were also alerted and collected scats during their scheduled camera checks.
For determining brown bear food habits in Albanian Prespa National Park, systematic field expeditions for bear scats collection were conducted by PPNEA Large carnivore(LC) research team. Most of the scats collected were aligned with camera trapping surveys conducted in the area. A total of 12 transects were designed based on the brown bear movement ecology, type of vegetation and on their accessibility to be reached physically by PPNEA LC research team. The scats were collected by at least 4 PPNEA employees and several volunteer students from Fan S. Noli University in Korça.

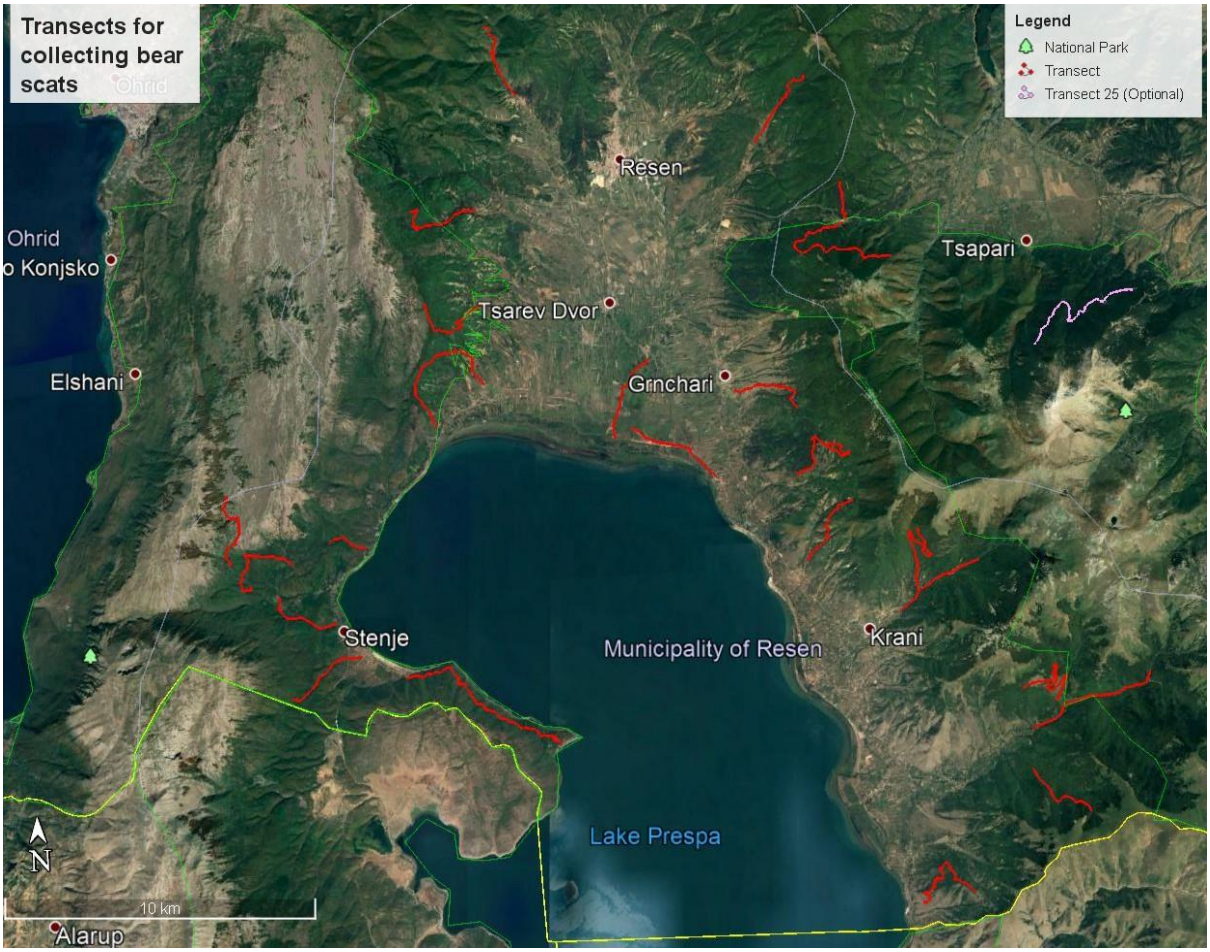

Photo 1. Transects on the north side of the Prespa Basin (North Macedonia).

All scats found on the field were collected in big zip-lock bags with a standardized form used in all three countries. Each scat was assigned a unique scat ID. Besides the paper form, we designed a digitalized version in Memento database app for Android devices, which was synchronized to a cloud server and all users could update the database. The database contains the following parameters: Sample code, Name of author, Date, GPS coordinates, Age of scat (0-1 day, 2-5 days, 6-15 days, 16-30 days, 1-3 months, 3-6 months and older than 6 months), Type of habitat, Microlocation (place of finding), General location, Sample for genetic analysis collected, Site (locality) and Notes & comments. The complete database was exported to Google Sheets and then converted to Microsoft Excel.

After the field, all collected samples were frozen in a freezer until enough samples were collected for the laboratory analysis.

The methodology used for the laboratory analyses is described in **Cicnjak et al. (1987)**.
The analysis was carried out in two phases, during which the scats were measured and their contents rinsed. In the first phase, all scats were measured for their mass and total volume, using a digital scale for the former and graduated cylinders for the latter. In the second phase, the scats were washed through a sieve, and the species of all items remaining in the sieve were identified where possible. The identified items were measured for their volume to calculate their **percent volume**. The difference between the sum of volumes of all identified items and the total scat volume was labeled as unidentified. In most cases, that referred to the amorphous mass that was almost or fully digested.
Each food item has its own **frequency of occurrence**, which is calculated when dividing the total number of times that particular item was present in the scats to the total number of all scats, multiplied by 100 to get a percent value.

The ants and grass species were identified to the taxonomic level of family. All the fruits were identified to the taxonomic level of species, or in a few cases to genus. The ants were always found mixed with soil, so their volume could not be accurately measured. In those cases, we decided to have a uniform way of quantifying it and stated the ant volume to be 0,5 ml. In cases where small amounts of seeds were found, we stated 1 ml for each wild cherry and European cornel seed and 1,5 ml for each cherry plum seed. For apples and wild pears, the volume of seeds was stated as 0,5 ml. The volume of each individual food item in a scat was measured by water displacement to the nearest milliliter, giving the percent volume of each identified item. All unidentified seeds and hairs were collected in separate zip-lock bags on which the scat ID was written. The samples were kept in freezer for further analysis under the microscope and using identification keys. The results were written on paper forms, one for each scat sample and then inserted into an Excel database.

- **Results**

Of the 553 scats, 87 were 0-1 day old, 206 were 2-5 days old, 125 were 6-15 days old, 101 were 16-30 days old, 26 were 1-3 months old, 7 were 3-6 months old and 1 was older than 6 months. The average scat volume was 416.3 ml (range 10-2880 ml) and the average scat mass was estimated to be 445 g (range 10-2843 g).

The results show that the most prominent food source for the bears was cherry plums (*Prunus cerasifera*), which were identified in 263 scat samples (Fig. 2), with a frequency of occurrence of 47.56% (Fig. 3). The average percent volume of cherry plums was 46.47%.

The second most common food item were grasses (*Poaceae*) found in 111 samples (Fig. 2) with a frequency of occurrence of 20.07% (Fig. 3) and an average percent volume of 45.63%.

Other notable food items include acorns (*Quercus sp.*), apples (*Malus domestica*), wild cherries (*Prunus avium*) and European cornels (*Cornus mas*) with frequencies of occurrence of 18.63%,

15.55%, 15.19% and 11.57% and average percent volumes of 69.615%, 54.87%, 55.14% and 36.05% respectively (Fig. 3).

Wild pears were present in 52 scat samples (frequency of occurrence 9.40% and percent volume of 60.77%) , ants in 39 samples (frequency of occurrence 7.05%, Fig. 3), however, their percent volume could not be accurately measured as they were always found mixed with a lot of soil.

Beechnuts (*Fagus sylvatica*) were found in 13 samples, blackberries (*Rubus fruticosus* agg.) in 14, figs (*Ficus carica*) in 2, grapes (*Vitis vinifera*) in 10, haws (*Crataegus monogyna*) in 1, hazelnuts (*Corylus avellana*) in 6, Hermann's tortoise (*Testudo hermanni*) in 18, juniper berries (*Juniperus communis*) in 1, maize (*Zea mays*) in 2, raspberries (*Rubus idaeus*) in 2, rosehips (*Rosa canina*) in 9, walnuts (*Juglans regia*) in 14 and wheat (*Triticum vulgare*) in 9.

Compared to the plant based portion of the Brown bear's diet, their carnivorous dietary habits were significantly lower. The most notable food item in this category is Hermann's tortoise (*Testudo hermanni*), found in 18 scats. Other traces of food of animal origin were found in the form of hair, crushed bones or pieces of skin. In total, 94 scats contained food items of animal origin (excluding the ants).

Out of the total 553 scats, 203 scats had some parts from the total volume that were digested or could not be identified using our method. That portion of the scats was labeled as unidentified.

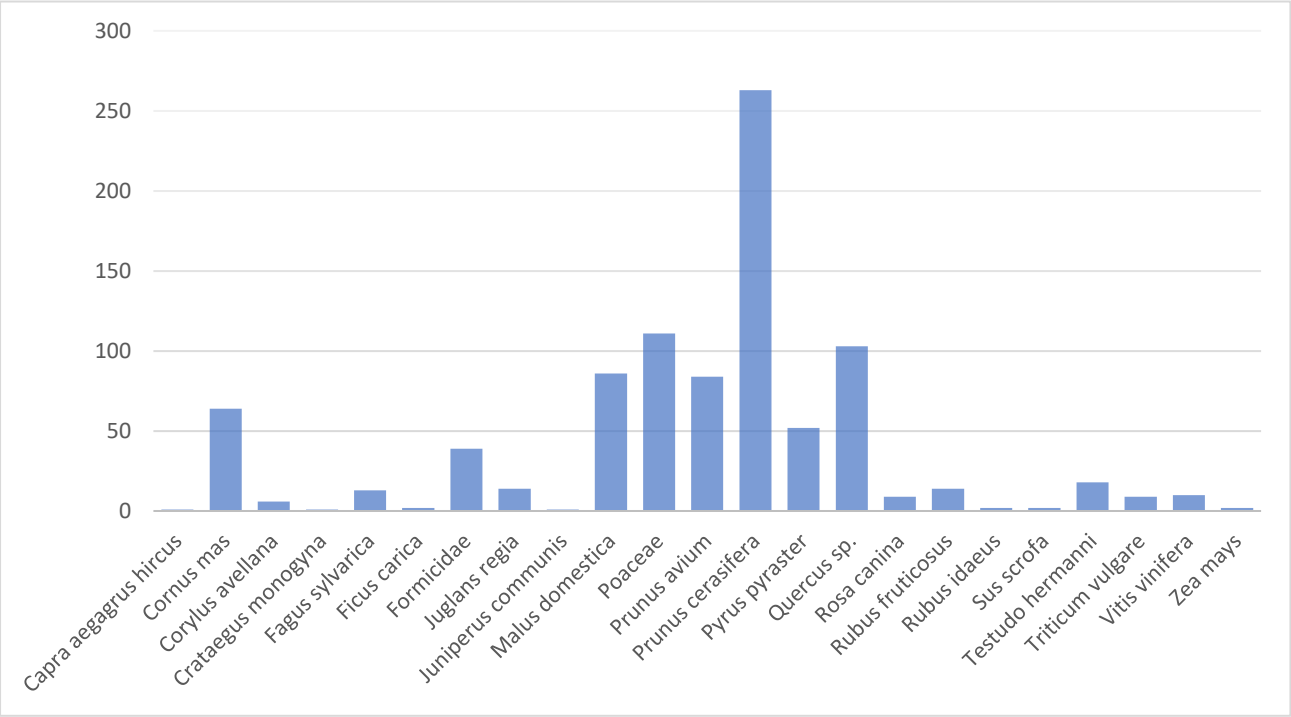

Figure 2. Number of occurrences of individual food sources found in scats

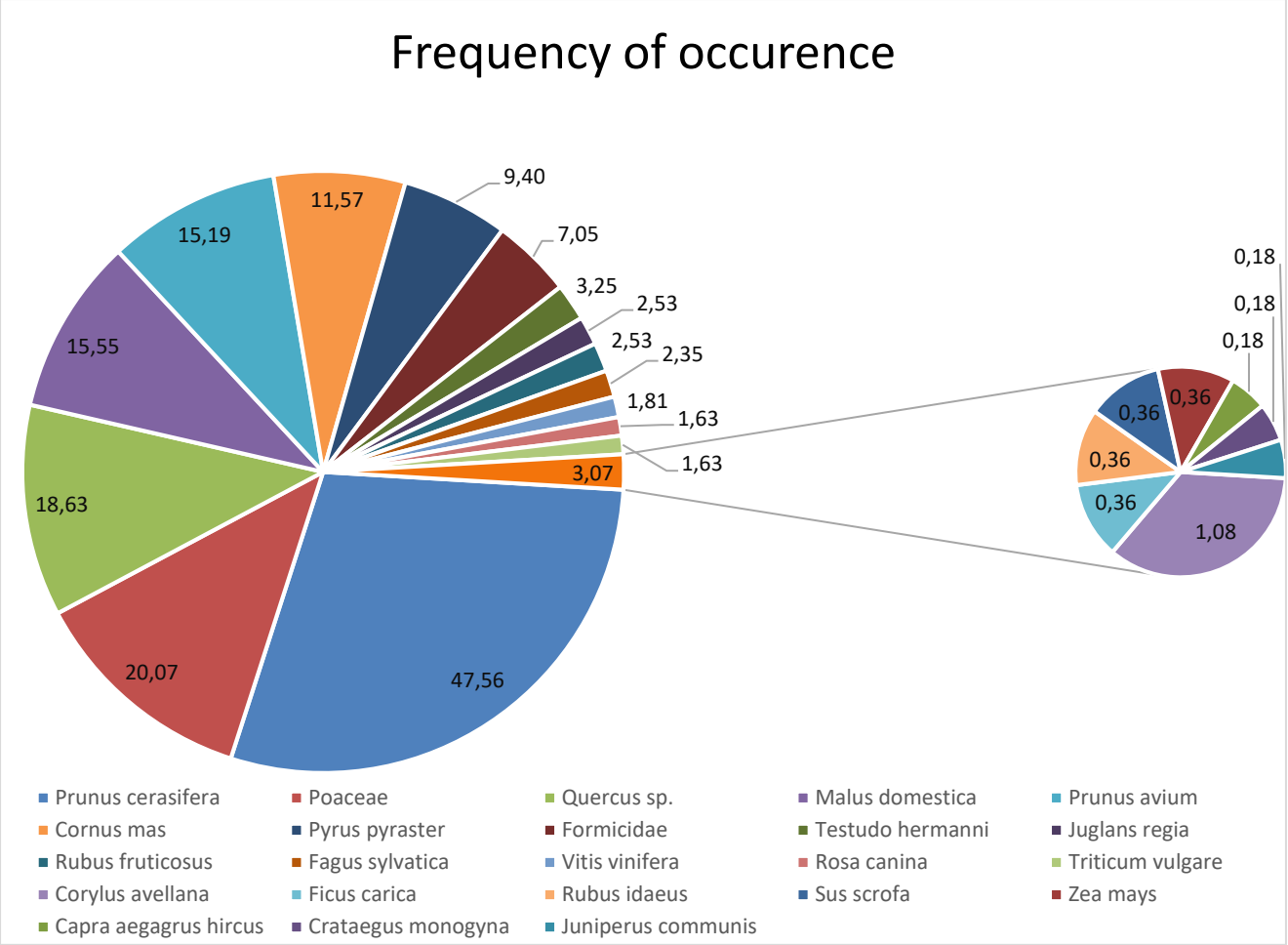

Figure 3. Frequency of occurence of individual food sources in scats

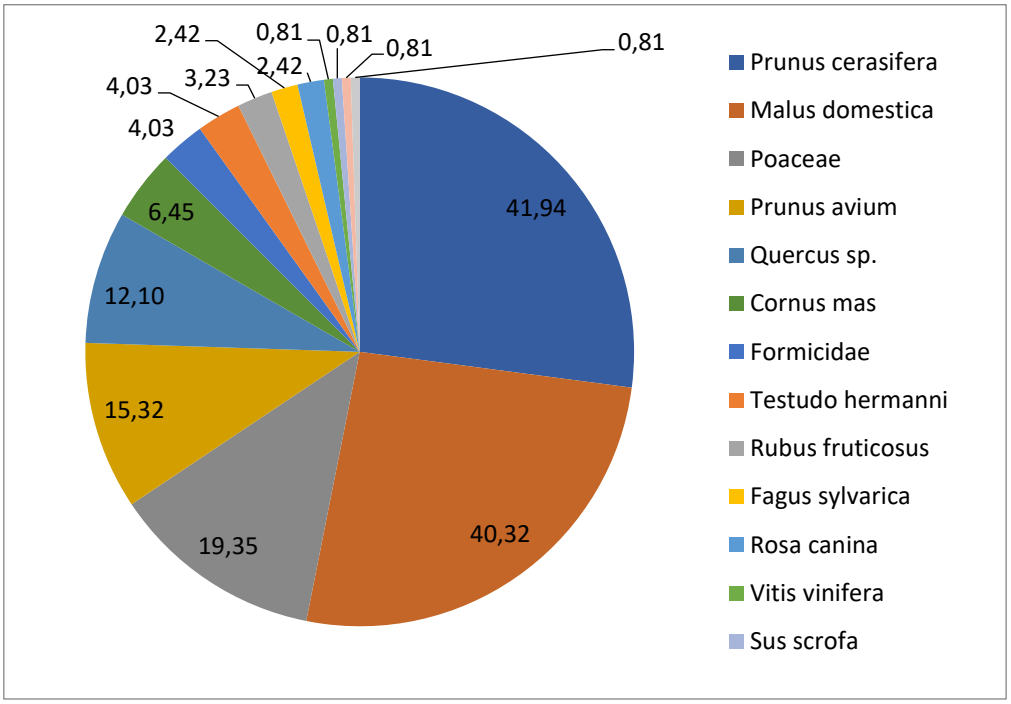

Figure 4. Frequency of occurrence of individual food sources in scats collected from the Macedonian side of Prespa

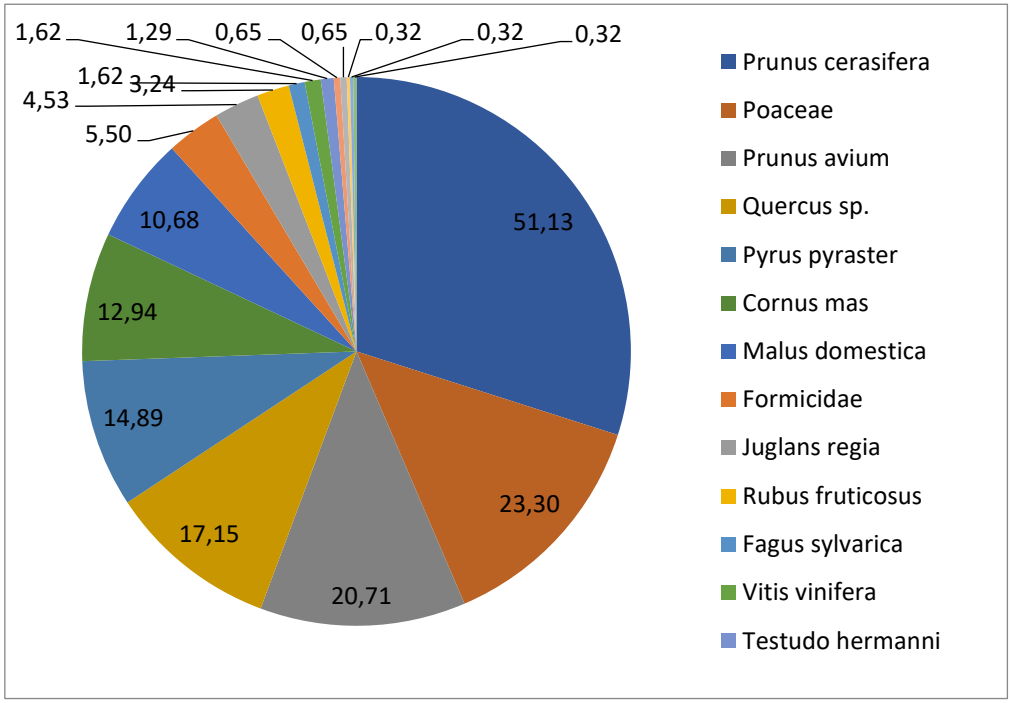

Figure 5. Frequency of occurrence of individual food sources in scats collected from the Greek side of Prespa

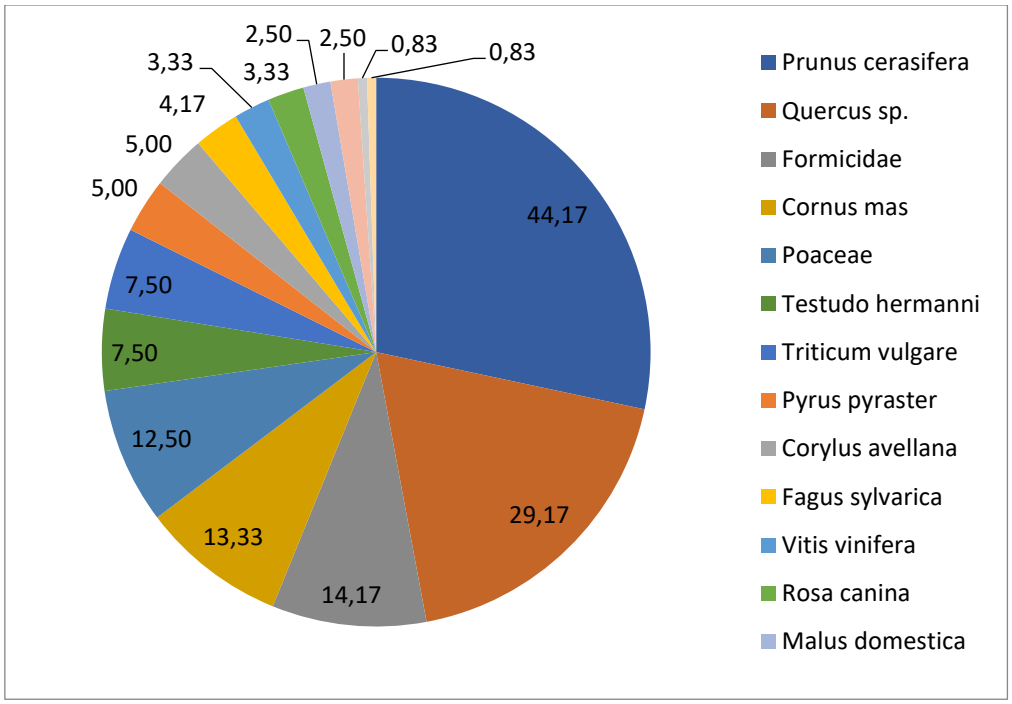

Figure 6. Frequency of occurrence of individual food sources in scats collected from the Albanian side of Prespa

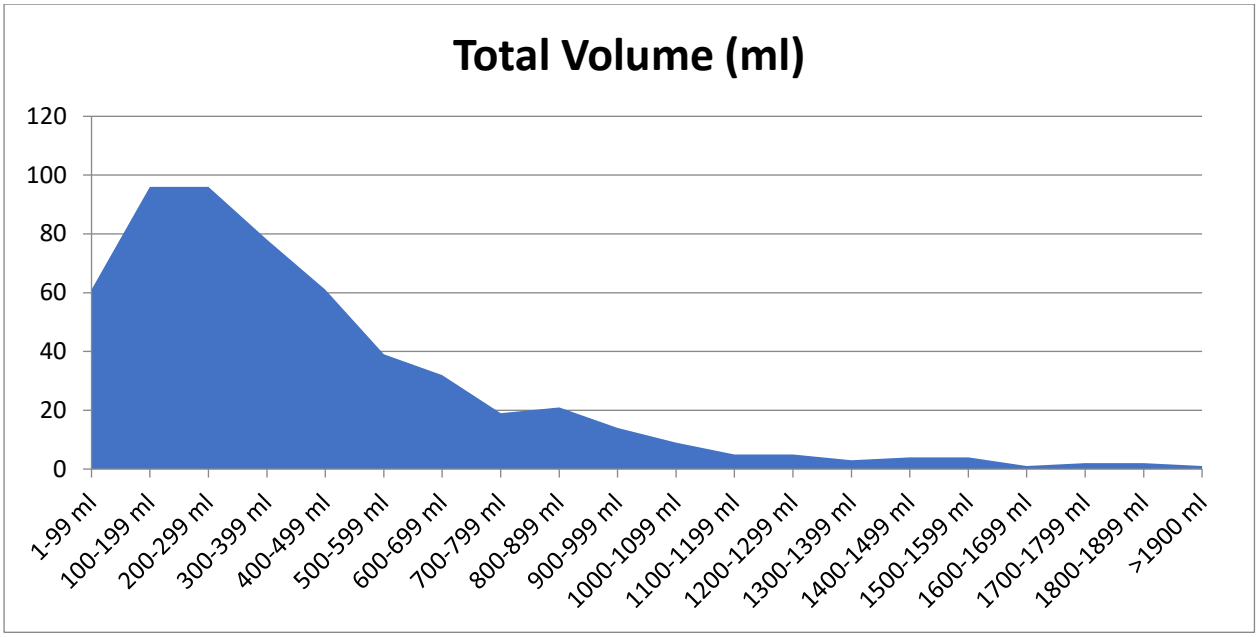

Figure 7. Number of samples organised in 20 total volume categories

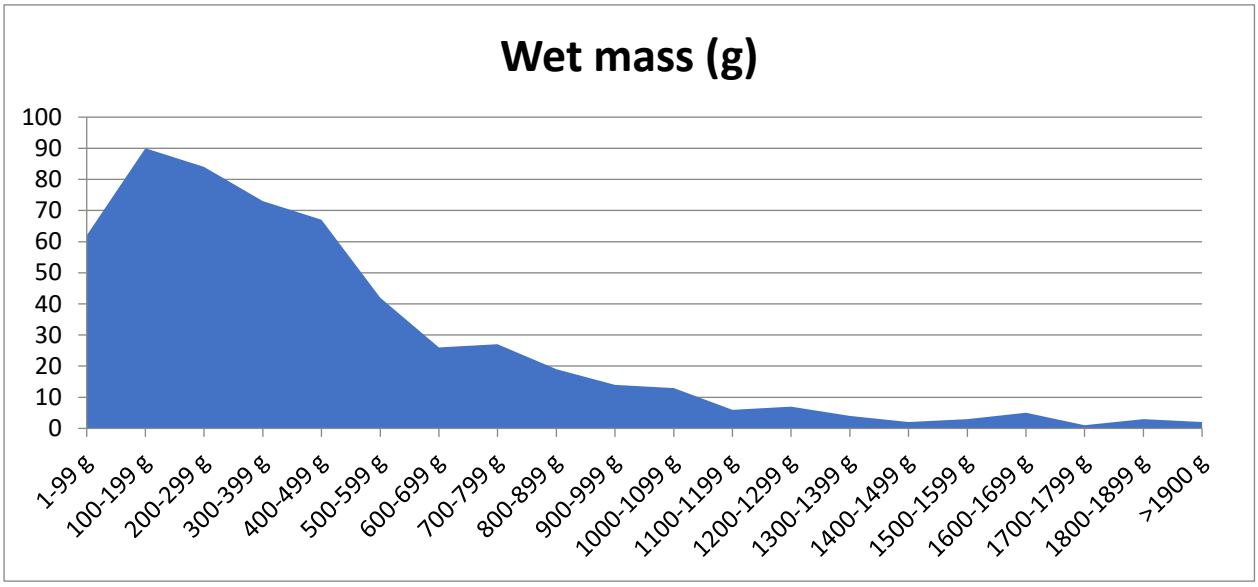

Figure 8. Number of samples organised in 20 wet mass categories

- **Conclusions**

This study yields the first insight into the Brown bear dietary habits in the Prespa basin. The results of this study show that the diet, and possibly even the behavior, of the Brown bear differ to some degree in all three countries. With that knowledge in mind, the results could be implemented in future conservation and management action plans, ensuring a more sustainable development of the region.

These kind of analyses can be a valuable asset in areas where the populations of this large carnivore species are larger, in order to lessen the potential human-bear conflict.