

Signs of the bear life activities and their utilization for the monitoring of the brown bear (*Ursus arctos* L.) in Bulgaria

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Abstract: A number of signs of the life activity of the brown bear (*Ursus arctos* L.) (apart from bear footprints: scats, tree markings, overturned stones, messed ant-hills and damaged fruit trees) which give the opportunity to detect the presence of the animal and, in several cases, to identify the different individuals, are analyzed. The identification after the individual habitus is also discussed. These features could add complementary information to the footprint identification during the monitoring of the brown bear in Bulgaria.

Key words: *Ursus arctos*, Bulgaria, bear signs, bear markings

Introduction

The official monitoring of the brown bear (*Ursus arctos* L.) in Bulgaria for evaluation of the status of the species is conducted by several years. This monitoring is currently based mainly on the identification of the bear footprints, a method proposed in the project of the Executive Agency of the Environment (EAE) "Development of National System of Monitoring of the Biodiversity and the Protected Areas in Bulgaria" – PPA03/BG/715 (2004), modified recently by some of us, and accepted by the Ministry of Environment and Wathers (MOEW). Several other signs of bear life activity (FORMOZOV, 1952; ATANASSOV, 1983; RUKOVSKY, 1984; SPIRIDONOV & MILEVA, 1987; RAYCHEV, 1989; PUCHKOVSKIY, 1990; SOBANSKIY & ZAVATZKIY, 1993; SPASSOV et al., 2000; SPASSOV, 2007; ETIENNE & LAUZET, 2009) could help the detection of the bear presence in the wild or the evaluation of the age, sex and number of the bears in the studied territory.

Material and methods

A number of signs of the daily activity, other than footprints, collected by the authors over the course of years of field work on the bear status in Bulgaria in the regions of Central Stara Planina, Rila, Pirin, Western Rhodopes and Vitosha Mts, (but

also in Eastern Karadeniz Mts., Northern Anatolia, Turkey, 2015), are analyzed: markings on trees, traces of the feeding activity of the bear as scats, overturned stones, messed ant-hills, damaged fruit trees etc. For the age/sex identification of the scats over 70 shaped excrements were measured at the thickest part of their middle portions, using calipers, compasses and tape measure. The sex and age of individuals was identified by footprints. To study the status of the bear in Vitosha mountain 4 camera-traps were used (set to take 15 sec long videos automatically activated by motion and with infrared flash for nocturnal capturing). They were placed for 17 days in the game feeding places of Vitoshko game husbandry, where bears are concentrated in the spring.

Scats and feeding behaviour as an indication of bear presence

Scats. Most often bear traces and scats could be seen in muddy places along the forest trails, close to the foraging places for the game in game husbandries or near fruit-trees. However, despite the fact that the size and shape of the excrements could vary significantly due to obvious reasons, our long term observations show that the width of the well-formed excrements guide the defining of the age and sex of the animal especially in terms of identification of

the mature adult males. ETIENNE & LAUZET (2009) point out that the width of scats of the European bear varies between 3 and 7 cm. According to our observations the scats of the adult males are usually 5/5.5 – 6 cm wide, sometimes even wider (see also: SPASSOV et al., 2000), while the scats of the adult females are most often 4-4.5 cm in width. Measured excrements of subadult bears in their third year are usually around 3 to 3.5 cm, and of the cubs – below this size (example: measured scats of mother and two years old cub observed in Stara Reka Reserve in Central Balkan Mountains, which were 4.5 and 2.8 cm in width: SPIRIDONOV & MILEVA, 1987).

Considering the significance of the bear scats for individual identification, it should be noted that the age group and the sex of 52.7% of the bears detected by us were identified by the size of their foot prints, but 33.0% of them – by the size of their excrements. The other signs of bear activity (including direct observations) helped identify the presence of 14.3% of the bear individuals detected by us during the field research related to the project of Natura Consortium for mapping of the habitats in the Natura 2000 zones (2011-2013).

The colour of the scat is related to the food of the bear and its freshness and the consistency of the excrements depends on the food which varies during the different foraging sites and depending on the seasons. We ascertain considerable seasonal, vertical and horizontal movements of individuals. According to our observations (see also: RAYCHEV, 1988) in the spring, when plant food is limited, bears feed mainly on grass which they initially find in the lower free of snow sites and later in the high mountain pastures. After the end of the blueberry season, the grass again becomes the main diet component in the coniferous forests, which are poorer in feeding resources compared to the deciduous ones in the autumn. The scats in which the grass dominates (according to our observations in the Western Rhodopes) are greenish and become darker with the time but the traces of grass remain green inside the excrements for a long time. The scats after blueberries consumption are dark-violet to black and become darker with time (in about a week). Similarly to other carnivores, bear scats after feeding on meat are black. Usually they contain ingested hair (Fig. 1). Besides supplying the meat



Fig.1. Excrements of an adult male with hair from wild boar, and grains of corn Rakitovo state Forestry, the Rhodope mountains (photo: N. Spassov, 2011)



Fig. 2. A fragment of the scat of an affrayed young bear rich in indigested oak acorn shells (Karadeniz Mts., North-East Anatolia, Turkey, photo: A. Ignatov, 2015)

portion in their diet through scavenging, bears can hunt actively as well. We have recorded about four cases of male bears stalking and attacking young wild boars – from the regions of Trigrad, Smolyan, Rakitovo and the state forestry of Seliste (Rhodopes). The fresh scats after feeding on cherry plums or blackberries are watery and not well-shaped; they are pale yellow in colour and rich in fruit stones and very often in skins of the fruits. In late summer and the beginning of the autumn such scats could be seen in great number and should be searched for in close proximity to the territories where cherry plums are abundant, gorges, meadows in the lower mountain regions and close to abandoned agriculture lands. The fresh scats after feeding on corn from the game supplementary feeding stations are yellowish; rich in indigested seeds (they become darker in 1-2 days and frequently are well-shaped). The scats of oak and beech acorns are well-formed, reddish-brown to dark brown, rich in indigested acorn shells (Fig. 2).

Feeding behaviour: Overturned stones, messed ant-hills, and damaged fruit trees

In search for invertebrates the bear often turns over big stones. However, not all capsized large stones observed in the forest are a result of such bear feeding behaviour. Frequently the field researcher could be misled by stones turned over by tourists and foresters or – in the periphery of the road – by cars. Stones could be capsized by wild boars in search for food as well (Fig. 3.); when stones are overturned by bears there are usually several capsized stones, rather than a single one.

Assessment of the impact of bears on the ant-hills of four forest ant species has been provided by

ATANASSOV (1983). The ant-hills could be destroyed by wild boars or other animals as well, while when they are accidentally trampled by wild horse or cow this usually leaves a deep footprint in the ant-hills. The bear frequently throws away considerable part of the ant-hill aside (Fig. 4) and could destroy it almost completely to its base. In a region where the ant-hills have been dug up by bears, these are usually not single cases.

When the fruits ripen the fruit trees (especially cherry plums and plums) they are frequented by number of bears. The trees that are regularly visited and picked up by bears often have twisted or broken branches and traces of claws on the trunks. Branches twisted and broken by the snow could be mistaken for traces left by the bears on the fruit trees.

Marking behaviour

Leaving marks on trees represents typical bear behaviour with multifunctional meaning which is not completely clarified yet. It seems that the females and the cubs can also leave marks: however, such marks are the most typical for the mature territorial males especially during the breeding season (RUKOVSKIY, 1984; PUCHKOVSKIY, 1990; PAJETNOV, 1990; SERYODKIN, PACHKOVSKIY, 2006). We have established marked trees during the period 1997-1998 in the Central Balkan Mountains – the Rositsa and in Karlovo State Forestries, as well in the Dzhendema reserve (in the basin of Tuzha river). Such were also discovered in Bistrishko Branishte reserve (Vitosha Mountain). Considerable number of marks were discovered during the present assessment period from July 2011 through October 2012 as well as in 2014 in the Mazalat hunting husbandry, and the hunting husbandries of Rositsa, Tvarditsa Balkan, Teteven Balkan (Central Balkan), Rila National Park, Rila Monastery Forest (Rila Mountain), Slavyanka Mountain, the hunting husbandry of Adzhilarska Reka near the village of Kozhari (Western Rhodopes) (Figs. 5-7). The height of the claw marks found by us (19 in total) varied from 178 cm (Bistrishko Branishte) to 240-245 cm in the hunting husbandry of Mazalat on a spruce near a game feeding site. The mark is often peeled bark but sometimes only deep claw traces are left on it. In six of the cases, the fresh traces coincide for sure with the mating period (Tvarditsa Mountain and Adzhilarska river– May; Rila monastery forest – June; Alibotush reserve in Slavyanka Mountain – in the beginning of July). In one of these cases a marking left by a male bear by stamping down the ground with paws was recorded (leaving large footprints of paws: for examples of



Fig. 3. Sign of the feeding behaviour of the bear: upturned large stone, The Rilamountains, above Semkovo (photo: N. Spassov, 2012).

such type of marking see PUCHKOVSKIY, 1990), while in two of the cases the presence of female bear was registered in direct proximity to the markings. In Central Stara Planina and the Alibotush reserve, we have established marking by teeth (such behaviour is known from different parts of the vast bear area, for example from Altai: SOBANSKIY & ZAVATZKIY, 1993). In such cases the distance between the marks left by the canine teeth or the height of the marking could give an idea for the size of the male bear. In one of the cases along the Tuzha River tooth marks were left on a fallen tree in close proximity to an inhabited den. Marking by teeth from four-legged position – at a height of about 100 cm (distance between the marks left by the upper canines approx. ~ 5 cm) was observed on a tree trunk at the site of Babski rut in Tuzha (SPASSOV et al., 2000; SPASSOV, 2007). In Rositsa hunting husbandry marking by teeth from upright position at a height of 170 cm was registered, while that in Alibotush reserve has been at a height of 175 cm. The marks were most often near trails used by both bears and humans. The cases observed by us were mainly marks on coniferous trees (which coincides with the data from other authors as well: PUCHKOVSKIY, 1990), and also on impregnated wooden poles or pillars (for similar cases see also PAJETNOV (1990). Probably the stronger smell of the resin of the coniferous trees is an additional stimulus for the marking male bear. The same could be valid

for the strong odour of the impregnated wooden poles (for a similar opinion regarding the attracting role of the strong smells in the marking see also ETIENNE & LAUZET, 2009). A scratching point was found also at the base of beech on a forest road in Slavyanka Mountain. When the bears use the same tree a number of times they leave traces by rubbing with their back and head. On a century old spruce tree used numerous times for scratching, a dense dark patch was left at a height of about 2 m made by head rubbing and witnessing the presence of a territorial male. In similar cases hairs from the animal stuck on the tree remain.

Other tracks on trees: the case of peeled off Macedonian pines

Widely distributed specific behaviour of the bear in our mountains is peeling off the cover of coniferous trees. In the great majority of the cases this has been observed on the trunks of Macedonian pine (*Pinus peuce*) in Rila and Pirin. In June 1985 in Bayuvi dupki – Dzhindzhiritsa Reserve (Pirin Mountain) at the edge of the forest, a line of approximately 20 Macedonian pines with a diameter of 20-25 cm, were found marked by fresh traces – the bark scratched by claws and peeled off at a height till 1.30 – 1.70 m. In the abovementioned mountains a number of Macedonian pines peeled off by bear were observed by us in 2009-2013: in Rila – above



Fig. 4. Sign of the feeding behaviour of the bear: destroyed ant-hill, The Rilamountains, above Sitniakovo (photo: V. Ivanov, 2012)

Kamenitsa Hut; above Tchakar Voyvoda Hut; above Parangalitsa reserve; in Rila Monastery Forest; in the region of Belmeken Peak (here approximately 15 Macedonian pines were found in August 2012, peeled off probably several months previously); in Pirin – below Bezbog Peak; along the road Pirin hut – Semkovo; in Bayuvi Dupki – Dzhindzhirtsitsa reserve; between Aramibunar and Vapata (in this case: 13 peeled off Macedonian pines with marks of different age – between 2-3 to ~ 10 year old). Unlike the cases of Rila and Pirin Mountains among the investigated Macedonian pines in Vitosha Nature Park (below Goli vrah) and during the intensive field research in Tsaritchina reserve (Central Balkan Mountains), peeled off Macedonian pines were not observed. It seems that the bear peels off other coniferous species in the places where Macedonian pine doesn't occur. In Rila and Pirin we have observed only two cases of other coniferous species peeled off – Scots pine (*P. sylvestris*) in the area between Arami Bunar and the village of Kremen and a fir tree (*Abies alba*) above Sitnyakovo in Rila Mountain (Fig. 8). The spruce (*Picea excelsa*) ranks second in terms of peeled off trees, but found outside the region of Rila and Pirin. In July 2011 dozens of peeled off spruces were



Fig. 5. Marking with nails: 240-245 cm height, Mazalat Forestry, The Central Balkan mountains (photo: N. Spassov, 2012)



Fig. 6. Marking behaviour with canines from upright position, Mazalat Forestry, The Central Balkan mountains (photo: N. Spassov, 2012)

discovered in Beglika area, Western Rhodopes, on an area of approximately 100 ha. Five freshly peeled off Scots pines were found in Izvora site above the village of Borino (W. Rhodopes).

Very often the trunk is peeled off lower – at the base of the tree. Attached hairs from the paws and the head of the animal can be seen. Relatively young trees (diameter 30-50 cm) are peeled off more frequently but the cover of very old (century old) ones could also be peeled off. The same animal can visit the same region with marked trees for years (see above). At places, the height of such peeled off zone reaches from the base of the tree up to 1, even 1.9 m. Sometimes its width can cover most of the tree in diameter and even the whole bark at the base of the trunk could be peeled off. In such cases the trees dry up.

On June 16th above Chakur Voivoda Hut (NP Rila) a bear peeled off eight Macedonian pines at a distance of about 1,300 m for one night (Fig.9). In one of them 75% of the bark at the base of the trunk was peeled off. The width of the peeled off part was 94 cm at a height of 60 cm. The freshly (several hours

ago) peeled off Macedonian pine has an absolutely white trunk at the place of the peeled off bark. The resin has just started to ooze. The pieces of the peeled off cover are still wet. In a week the peeled off part of the tree is abundantly covered by flows of resin. The resin is still white. The dried up resin on a peeled off trunk a year ago is dark yellow at the peeled off area. In very old traces of peeling off the resin eventually disappears with time. The cover is peeled off by claws. Their traces are visible on the trunk and in the parts of the peeled off cover poked by the claws. On the freshly peeled off trunk traces of the incisors (probably due to licking the resin) could be seen.

It is not clear if this behaviour has marking meaning (it is most intensive in the late astronomic spring which practically coincides with the breeding season). The highest intensity of the peeling off (maybe 90% of the cases) is highest in the spring up to the end of June. In any case, such behaviour looks like a feeding one in the widest meaning of the term and we believe it has curative meaning. It seems that similar behaviour is also recorded



Fig. 7. A bear marking tree (diameter 50 cm) in Adjilarska reka hunting Forestry, Western Rhodopes. The bark of the base of the tree is erased from regular scrubbing of the bear body made from position of four legs (photo: N. Spassov)



Fig. 8. Peeled bark of a pine spruce (*Abies alba*), Rilamountains, above Borovets (photo: N. Spassov, 2012)



Fig. 9. Peeled bark of Macedonian pine (*Pinus peuce*), 10 hours ago, and about 10 days ago, the Kaiser path, Rila mountains (photo: N. Spassov, 2012)

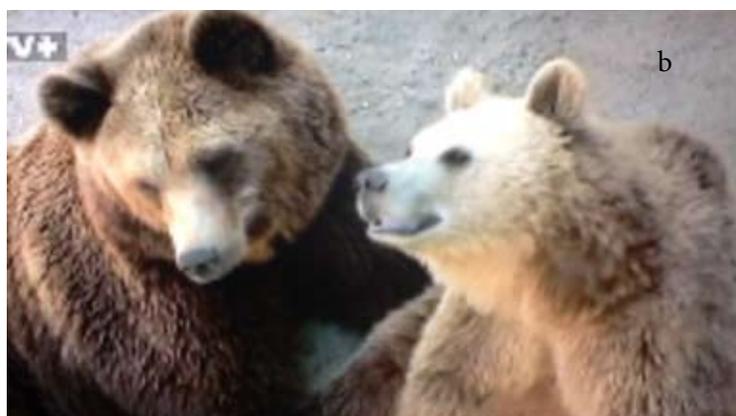


Fig.10. The bear habitus:

a. An adult male

(a photo from a camera-trap, Vitoskohunting Forestry. Photo V. Ivanov);

b. male (to the left, 5 years old) and female (4 years old) bears from Bulgaria. Lovech Zoo.

(Photo: H. Mihailov)

in coniferous forest regions in the Carpathian Mountains, Sweden, Finland, France (the Pyrenees) and in Spain (Cantabrian Mountains where the bear attacks, although rarely, chest nuts and willows as well) (ETIENNE & LAUZET, 2009). According to these authors the tree resin which is rich in amino acids and sugars has high feeding value. At the same time we must point out that local people in Rila and Pirin believe that coniferous resin, especially that of the Macedonian pine, is curative. In Pirin area the resin of Macedonian pine is used for treatment of stomach problems. Studies show that among the local tree species the Macedonian pine has the highest production of resin (STEFANOV, 1934). It is possible that the bear peels off the cover and licks the fresh resin looking for some kind of treatment (against intestinal parasites?).

Bear habitus and using of camera-traps for bear identification

The observations of bears in the wild and the analysis of the data obtained through camera-traps give important information about the sex, age and the individual characteristics of the animals. A very specific characteristic of the south European population which includes the Bulgarian bears is the occurrence of a large percentage (even predominance) of bears with contrast colouration – dark paws and withers and lighter (to golden) colour of the body which is lightest on the head and neck (SPASSOV, 2003). In the north of the European part of Russia bears with golden neck and head are about 4% of the population (PAJETNOV, 1990), while in Bulgaria they are very common and typical for the population. There is no sexual dimorphism in

the colouration of the European bears, after some investigations in the more northern territories of the continents, but according to our current observations the lighter (golden, 'blond') colouration occurs more often among the females although this has not been statistically proven yet. (The influence of the colouration on the probable hybridization with individuals from a more northern population that have darker and monotonous colouration as a whole has yet to be investigated by genetic tests). In terms of the analysis of the photo trap videos it should be taken into consideration that the head of the female seems more delicate, with a more pointed muzzle; the head of the adult males (en face) is proportionally bigger and the muzzle has more angular contours and is evidently more massive in its anterior part. The old males standing en face impress by their massive (almost as wide as high) body (Fig 10). The young males (comparison made during the same season) look more long-legged than the adult ones due to the lesser body mass they accumulate. Young bears (till their 3th year of life) are often lighter in colouration, with light end of the hairs (PAJETNOV, 1990).

Camera-trap identification combined with footprint identification were used by us for evaluating the bear number in Vitosha mountain. According to the data from the camera-traps in Vitoshko hunting husbandry in May 2013, there were at least eight bears in the area: a territorial male and an oestral

female in mating period (Fig. 11), a female with two second year cubs, and a female with two cubs from this year. In this way it was proven that the mature female individuals were three, and the presence of one territorial male was confirmed. If we include in this calculation a young animal from the previous year (which is registered by footprints but not by the photo traps) the number of the bears becomes at least nine. It is very possible that one more animal has inhabited Bistishko Branishte reserve at that time. Thus the maximum bear number for the territory of Vitosha Mountain could be about 10 individuals. It should be taken into account that some of these individuals spread their individual territories in the neighbouring mountains – such as Verila, Plana and even Lozenska Planina, as well.

The data from the camera-traps as a whole confirm the data obtained through the tracking of the footprints and prove that the combined method could produce reliable data, with an accuracy of up to ca. 90%, assuming it is applied to a relatively limited territory. Based on the concrete data obtained through the present study, the claim (DAMIANOV et al., 2008) that the territory is inhabited by eight female and six male bears (cubs not included) based on unclear taxation method seems exaggerated.

The territory inhabited by the species covers the potential habitats of the species of approximately 24,000 ha, with four breeding individuals, while



Fig. 11. A temporary pair in mating season (17.05.2013). Vitoshko Hunting Forestry, Vitosha mountains (a photo from a camera-trap, V. Ivanov)

the bears are rarely seen as in the northern part of the mountain. The relatively low average density of the bears in Vitosha – one individual per ca. 3,000 ha (including cubs and keeping in mind their individual weight compared to the one of the adults) is not evenly distributed since the animals avoid (especially during the day) the areas of the huts and the vicinity of roads in the northern part of the Mountain. Mainly during the spring due to the supplementary feeding of the game, bears concentrate on a smaller territory of approximately 20,000 ha in Vitoshko hunting husbandry (density of about 2,000 ha per individual, if we take the cubs into consideration, and approximately 3,000 ha without them, e.g. – about 2,500 ha per individual). The age structure is normal for a breeding bear population.

Conclusions

A number of signs of the life activity of the bear (a part from the bear footprints) as scats, tree markings, overturned stones, messed ant-hills, and damaged

fruit trees, permit detecting the presence of the animal and in several cases (scats and bear trees) identifying the different individuals. Some of the traces of bear life activity (bear trees) could have different “hand” in different regions. Thus these signs of the bear presence in the wild could add complementary information to the footprint identification during the monitoring of the brown bear in Bulgaria.

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Следите от жизнената дейност на мечката (*Ursus arctos* L.) и приложението им при теренния мониторинг на вида в България

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(Резюме)

Анализирани са значителен брой следи от жизнената дейност на мечката (отделно от следите от стъпки) като: екскременти, различни маркировки върху дървета, обърнати в търсене на храна камъни, разровени мравуняци и счупени клони на плодни дървета. Те дават възможност за установяване присъствието на вида и в редица случаи за идентифициране на индивидите по пол и възраст. Дискутирани са и белезите по които индивидите могат да бъдат идентифицирани според външния вид. Всички тези белези могат да допълнят значително информацията, получена от анализа на следите от стъпки при монитирането на мечката в България.