

## LIVESTOCK DEPREDACTIONS BY LARGE CARNIVORES AS A FOOD SOURCE FOR AVIAN SCAVENGERS

### Plenjenje domačih živali s strani velikih zveri kot vir hrane za ptičje mrhovinarje

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Presence of food is the key factor determining spatial distribution of birds and their population dynamics (WIENS 1989). Avian scavengers often concentrate at cadavers of large mammals, for example at supplementary feeding stations ("vulture restaurants") frequently supplied with livestock carcasses (CORTÉS-AVIZANDA *et al.* 2009) and at cadavers of wild ungulates killed by predators (WILMERS *et al.* 2003, KROFEL 2011). Here we report on observations of avian scavengers in a pasture area with frequent livestock depredations by large carnivores and discuss the potential effects of presence of livestock carrion from depredations on spatial distribution and diet of scavenging birds.

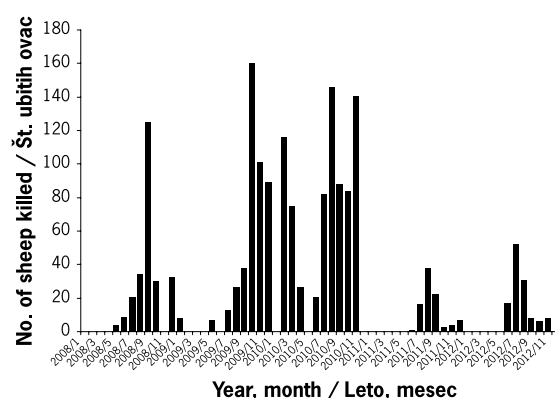
For our observations, we chose a high-karst pasture area at Volovja reber on the western edge of the Snežnik Plateau in the northern Dinaric Mountains (UTM VL44, SW Slovenia), where numbers of sheep killed by large carnivores are among the highest in Slovenia (ČERNE *et al.* 2012). The total grassland area, which is partly overgrown by smaller trees and bushes, covers around 14 km<sup>2</sup>. Most of the grazing animals in this area were sheep and, in a much lower number, horses. In these pastures, 400–800 sheep were present in two or three groups. Sheep were regularly grazing – in the pastures in spring, summer and autumn, while in winter it depended mostly on snow conditions, as animals were usually not there when the ground was covered by snow.

The presence of sheep carcasses in the last five years varied considerably and was closely correlated with the presence of sheep in the area and protection used against depredations. In Slovenia, the state pays compensation for the damages caused by large carnivores, so every damage case on livestock caused by large carnivores is reported, checked by the state officials from Slovenia Forest Service and georeferenced. We analysed temporal distribution of

damage cases at Volovja reber from 2008 till 2012. In 2008, 256 sheep were reported killed in these pastures, mainly by the Brown Bear *Ursus arctos* and Grey Wolf *Canis lupus*. The number of reported killed animals increased substantially in 2009 to 443 and in 2010 to 780 animals. In 2011, improved protection measures were implemented (high electric fences, by which grazing animals are enclosed during the night – "night enclosures"); the number of killed sheep dropped dramatically to 91 and 122 animals yearly in 2011 and 2012, respectively (Figure 1). In 2011, damages became mostly limited to depredations by the Brown Bears and in 2012 exclusively so. These damages occurred due to irregular closing of sheep and occasional low current in the electric fence owing to inappropriate grounding.

We were observing scavengers at Volovja reber in 2012. Most observations were made at a distance of about 200 m from the night enclosure using binoculars and during the night with the use of night-vision binoculars.

On 7 Aug 2012, we visited the pasture at 18.00 h and noted several sheep cadavers killed by the Brown Bear during previous days and/or weeks. At and in the vicinity of cadavers we noted ca. 50 Ravens *Corvus corax*, one Griffon Vulture *Gyps fulvus* and one Goshawk *Accipiter gentilis*. Soon after our arrival, the Griffon Vulture flew away, but was back in the pasture during our next visit one hour later. At dusk (around 21.00 hrs), only Ravens were still there, but they all left by the nightfall. At 21.50 hrs, the first Brown Bear



**Figure 1:** Number of sheep reported killed by large carnivores per month in pastures of Volovja reber during 2008–2012 (source: Slovenia Forest Service)

**Slika 1:** Število prijavljenih ubitih ovac zaradi napadov velikih zveri na pašnikih na Volovji rebri za posamezen mesec v letih 2008–2012 (vir: Zavod za gozdove Slovenije)



**Figure 2:** Raven *Corvus corax* riding on a sheep in the pasture at Volovja reber in the northern Dinarides, Slovenia, 16 Aug 2012 (photo: M. Krofel)

**Slika 2:** Krokav *Corvus corax* med čepenjem na ovci na pašniku na Volovji rebri v severnih Dinaridih v Sloveniji, 16. 8. 2012 (foto: M. Krofel)

arrived. We observed several bears during the night and at approximately 3.00 hrs on 8 Aug one of them crossed the electric fence and killed an adult sheep. Bears fed on the sheep for several minutes and then took it 20 m out of the night enclosure into the bushes nearby. We visited the kill site in the morning at 6.45 hrs and recorded 95 Ravens at the kill site and several more flying around. We observed several Ravens feeding on the sheep killed by the bear during the night. They were mainly eating from the parts opened by the bear and pecking in the eye orbits, so that eyes were already missing.

We made next observations on 15 Aug 2012. We reached the pasture at 19.15 hrs and observed eight Griffon Vultures and ca. 20 Ravens sitting on the pines along the ridge of Bele ovce above the pasture. Like in previous observations, several old carcasses were seen in the pasture. Later in the evening, Griffon Vultures circled above the pasture until sunset, when they descended back on the ridge in the vicinity of Bele ovce, where they probably spent the night. We observed the first bear at 21.45 hrs, and at 22.30 hrs it crossed the electric fence and attacked the sheep. Later we recorded several more sighting of bears, including a female with two cubs. However, it seemed that only one was crossing the electric fence and chasing the sheep. One sheep was killed during the night, and in the morning at 5.45 hrs we noted ca. 70 Ravens flying and landing in the pasture as well as on rocks and trees around and feeding on remains of the sheep killed during the night. We observed Ravens walking among the surviving sheep in the night enclosure, but

sheep seemed oblivious to them. We didn't notice any reaction even when one of the Ravens landed on the back of one of the sheep and rode on it for several minutes (Figure 2). We left the pasture at 8.30 hrs, before any of the Griffon Vultures was noted in the air.

The last visit to the pasture was made in the evening of 21 Aug 2012. We didn't notice any sheep cadavers. Several Ravens and Hooded Crows *C. cornix* were flying in the area, but it was not possible to determine their numbers. No vultures were observed.

Our observations confirm the importance of large carnivores for providing avian scavengers with carrion and the importance of scavengers, especially Ravens and Griffon Vultures, in the decomposition process of large cadavers. Griffon Vultures are the only regularly present obligatory vertebrate scavengers in Slovenia. They are known for their high effectiveness in locating ungulate cadavers (HOUSTON 1974) and Volovja reber ridge is situated along the migration corridor for Griffon Vultures between the Gulf of Kvarner and the Alps (MIHELIC & GENERO 2005). Therefore it is not surprising that they were using remains of the sheep killed by predators. We assume that regular availability of cadavers at Volovja reber affected their usually migratory movements, as they were probably present here for prolonged periods, evidently even during the nights.

Our observations indicate that the species that benefited most from livestock depredations at Volovja reber was the Raven, as these birds were observed during every visit with up to over 100 individuals at a time. Such concentrations are similar to artificial garbage dumps (TOME *et al.* 2008), which due to their regular availability of food probably constitute a similar kind of stable food source as the described pasture with regular depredations. In contrast, Raven numbers are usually considerably smaller at cadavers of wild ungulates killed by large carnivores (e.g. KROFEL 2011), which is possibly due to less predictable locations and more even (less concentrated) spatial distribution of such kill sites.

To estimate the importance of depredated sheep for diet of Ravens, we used data from diet analysis from pellets, which were also collected at Volovja reber (TOME *et al.* 2009). During the autumn of 2008, remains of sheep were found in 63% of Raven pellets collected on the top of Volovja reber ridge ( $n = 40$ ). In that year, prior to the establishment of night enclosures to prevent Grey Wolf attacks, 256 sheep were reported killed by Grey Wolves and Brown Bears, with the peak in September and October (Figure 1) when the pellets were collected. Therefore we assume that most, if not all, sheep remains in the analysed Raven pellets

came from these depredations. This indicates the importance of poorly protected pastures with regular large carnivore depredations for avian scavengers like Ravens. The importance of such prey remains for more opportunistic scavengers, like Goshawks that were recorded on mammal cadavers in this and previous studies (KROFEL 2011) only sporadically, is at present difficult to assess.

To our knowledge, this is the first reported case of the regular use of cadavers from livestock depredations by the scavenger bird guild. It indicates that locally increased availability of carrion due to inadequate livestock-prevention measures in the large carnivore habitat could affect the spatial distribution and diet of avian scavengers.

## Povzetek

Razpoložljivost hrane je eden glavnih dejavnikov, ki vpliva na razporeditev ptic v prostoru in njihovo populacijsko dinamiko. V prispevku obravnavava primer, ko so ponavljajoči se primeri napadov velikih zveri (rjavega medveda *Ursus arctos* in volka *Canis lupus*) na domače živali (ovce) zaradi slabe zaščite povzročili lokalno močno povečano dostopnost mrhovine. V obdobju ponavljajočega se plenjenja ovac s strani rjavih medvedov sva poleti leta 2012 na pašniku na Volovji rebri na zahodnem robu Snežniške planote v severnih Dinaridih (UTM VL44, JZ Slovenija) zabeležila redno pojavljanje ptičjih mrhovinarjev. Med posameznimi opažanji sva ob ovčjih kadavrih opazila do 100 krokarjev *Corvus corax*, osem beloglavih jastrebov *Gyps fulvus* in enega kragulja *Accipiter gentilis*. Analiza izbljuvkov krokarjev s te lokacije je pokazala 63-odstotni delež ovac v prehrani krokarjev. Sklepava, da je opisano plenjenje ovac vodilo do koncentriranja ptičjih mrhovinarjev na tej lokaciji in povečanja deleža mrhovine v prehrani krokarjev, kar je glede na dostopno literaturo prvo takšno opažanje stranskega učinka škod, ki jih na domačih živalih povzročajo velike zveri.

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