Tortoises as prey of three bird species in Bulgaria: Implications for tortoise reintroduction programs

In the past, the tortoise species *Testudo graeca* LINNAEUS, 1758 and *Testudo hermanni* (GMELIN, 1789) were widespread in the lowlands and the lower mountain regions of Bulgaria, but are currently experiencing

dramatic population declines (BESHKOV & NANEV 2002; STOYANOV et al. 2011). *Testudo graeca* is classified 'Vulnerable' and *T. hermanni* 'Near Threatened' according to IUCN (2011) categories, both are included in the Bulgarian Red Data Book as 'Endangered' (BESHKOV 2011a, 2011b). Tortoise populations were negatively influenced in the recent decades (BESHKOV 1984; PETROV et al. 2004), and this negative trend continues nowadays. The main reasons for this were mass harvesting during the 20th century, consolidation of arable land, and afforestation with conifers instead of the original deciduous trees and shrubs (PETROV et al. 2004). Consumption of tortoises by locals, despite the legal protection, is still relevant today (BESHKOV 1984; VETTER 2006; authors of this note, pers. observ.). Forest fires also contribute to significant decrease, habitat fragmentation and subsequent isolation of populations of both species (POPGEORGIEV 2008).

Predation by birds might affect tortoise populations, but this factor has received comparatively little attention with regard to the turtle species in question (for a summary see BUSKIRK et al. 2001; CHEYLAN 2001) and Bulgaria in particular (BESHKOV 1984; PETROV et al. 2004). Tortoises are an important part of the diets for the Golden Eagle, *Aquila chrysaetos* (LINNAEUS, 1758), and Egyptian Vulture, *Neophron percnopterus* (LINNAEUS, 1758), in Bulgaria, whose breeding populations also are decreasing (SIMEONOV et al. 1991; IANKOV 2007). No other avian species were peviously recorded predating tortoises in Bulgaria.

Reintroductions of captive bred tortoises planned to improve the status of their populations (PETROV et al. 2004) must take into account potential predators occurring in the region. On the other hand, if these potential predators themselves were in the focus of conservation measures, tortoises, as a prey, would contribute to the food supply and, thus recovery of the abovementioned declining bird populations.

The present communication provides new data regarding preying on tortoises by different taxonomic groups of birds in Bulgaria, to estimate its effect on reintroduction projects of captive-bred young tortoises in this country.

Horn scales (costals, vertebrals and marginals) from the carapace of an approximately two-year old tortoise were found in one pellet of a White Stork *Ciconia ciconia* LINNAEUS, 1758 (0.23 % of 438 analyzed pellets). A single horn scale (costal) from an adult tortoise was detected in another pellet. Since the corresponding animal of prey must have been too big for swallowing or killing by the White Stork, the scenario of ingestion remains unclear. The pellets were collected on 18 July, 2009, under trees near the River Izvorska (42°22'N, 27°27'E), where approximately one hundred summering, nonbreeding White Storks were roosted. These birds are preying in the meadows, uncultivated lands and pastures in the vicinity of the villages Izvor, Marinka and Tvarditsa (Burgas district). In this area bordered to the south by the open hills of the Strandza Mountains only few individuals of both tortoise species were found (authors of this note**,** pers. observ.). The prey spectrum of the White Stork in Bulgaria has not been studied (SIMEONOV et al. 1991) and this species is not mentioned among the potential predators of young tortoises by BESHKOV (1984). However, it seems that some White Storks learn to prey on young tortoises. MUŽINIC & RAŠAJSKI (1992) studied the diet of breeding White Storks in the central Balkan area and found remains of juvenile *T. hermanni* in half of the nests in Macedonia and in one-fifth of the nests in Serbia and Kosovo.

Costal and vertebral scutes from an approximately one-year old tortoise were found in each of two studied pellets of the Short-toed Eagle *Circaetus gallicus* (GMELIN, 1788). The pellets were collected under a tree used as a resting place in the eagle's nesting territory at the Ada Tepe Hill (41°25'N, 25°39'E) near Krumovgrad in the Eastern Rhodopi Mountains in August 2005. The population density of the tortoises in the sparse oak forest on the southern slope of the hill was comparatively high – 6.38 ind./ ha. The density (D) was estimated based on the formula ($D = n / 2Lw$), where n is the number of tortoises observed by two observers, each of them independently surveying the same transect (L) m long and (w) m wide. The survey on April 15, 2006, (L = 1960 m, w = 20 m) yielded:

T. graeca – 20 specimens, *T. hermanni* – 4 specimens, *Testudo* sp. – 1 specimen; B. M. and M. SLAVCHEV pers. comm.). On the whole, the above information resembles data by POPGEORGIEV (2008) from another region in the Eastern Rhodope Mountains with high tortoise densities (95 % confidence interval in parentheses): *T. hermanni* – 7.5 (5.4-10.4) ind./ha, *T. graeca* – 2.1 (0.9-5.0) ind./ha. The cadaver of a young *Testudo* sp. (3.7 % of the prey item remains in all three nests) was found in one of three investigated Short-toed Eagle nests in the Dadia Forest Reserve in the Greek part of the Eastern Rhodope Mts. (BAKALOUDIS et al. 1998), whereas no remains of tortoises were found in 48 pellets of this eagle species collected from the same region (VLACHOS & PAPAGEORGIOU 1994). The data suggests that young tortoises are opportunistically preyed by Short-toed Eagles in areas where tortoises are abundant. About 300 pairs of Short-toed Eagle currently breed in Bulgaria (IANKOV 2007), but due to their dispersion across the country they are unlikely to represent a major threat to local tortoise populations.

Remains of the shell, skeletal, and distal parts of legs with nails of an about 6-7 years old *T. graeca* were found among the food remains in a nest of the Eagle Owl *Bubo bubo* (LINNAEUS, 1758), in the Tundza River Valley near Elhovo, Yambol region, in June-August, 2010 (B. MILCHEV, pers. observ.). This tortoise was likely to be an exceptional victim as it represented only 0.6 % of this Eagle Owl's diet by number of prey items (n = 166) in 2010 (B. MILCHEV, pers. observ.). Only a single adult *T. graeca* was observed in the shrubs dominated by Christ's thorn, *Paliurus spina-christi* in the hunting territory of the Eagle Owl on 24 May, 2010 (size approximately 20 ha, three visits in 2010; B. MILCHEV pers. observ.). The prey spectrum of the Eagle Owl is well studied in Bulgaria, but tortoises were never found (SIMEONOV et al. 1991; OBUCH & BENDA 1996; SIMEONOV et al. 1998; MILCHEV 2008, 2009; MILCHEV unpubl. data from 55 Eagle Owl localities in SE Bulgaria since 1988). Tortoises are very rare victims of the Eagle Owl in other parts of its geographical range. Reports include two *Testudo* sp. in the Dadia Forest Reserve, north-eastern Greece (0.3 % of 630 prey items; PAPAGEORGIOU et al. 1993), one *Testudo* sp. in eastern Turkey (0.03 % of 3,004 prey items; OBUCH 1994) and an adult *Testudo* sp. in Lebanon (1.2 % of 86 prey items; BAYLE & PRIOR 2006). In conclusion, it seems that the Eagle Owl predation cannot be considered a real threat to tortoises in Bulgaria as the owl's presence is of occasional nature due to its relatively dispersed distribution (IANKOV 2007).

Reintroduction of tortoises is part of the national action plan for their conservation (PETROV et al. 2004). The first release of young individuals, bred in captivity, occurred near the resort Irakli, at the Black Sea coast in 2008 (IVANCHEV 2008). Similar programs are implemented successfully in Spain (BERTOLERO 1991; SOLER MASSANA et al. 2002) and France (STUBBS & SWINGLAND 1986). A preliminary study of potential resident and migratory predators that occur in the area selected for release should be incorporated in any reintroduction program. Of the three bird species reported here, the White Stork is the only one that is a widespread nesting species in the country with about 5,000 pairs (IANKOV 2007). Most notably, numerous specimens with an average of 135,000 individuals cross the Bourgas Bay during the autumn migration (SIMEONOV et al. 1991). Spring migration includes the period April-June (SIMEONOV et al. 1991; MILCHEV & KOVACHEV 1995), when the tortoises are most active (STOYANOV et al. 2011). The White Stork preys in a variety of open habitats such as sparse shrubs, and near edges of forests, coincidentally habitats of primary importance to the tortoises (SIMEONOV et al. 1991; BESHKOV 1984). When planning release of juvenile tortoises, locations used by the White Storks for resting and feeding should be avoided, as well as places that fall on the migratory route along the Black Sea coast. Under certain circumstances local concentrations of migrants may have a negative effect on reintroduction initiatives.

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