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SURVEY OF GOLDEN JACKALS (*CANIS AUREUS* L.) IN NORTHERN DALMATIA, CROATIA: PRELIMINARY RESULTS

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Preliminary results from the survey of golden jackals (*Canis aureus*) in Northern Dalmatia are presented. We used broadcasted jackal howls and monitored the response to determine the presence of jackal territorial groups. 19 jackal territorial groups were recorded in the NW part of Ravni kotari and 2 on Vir Island. The presence of territorial jackals on Pag Island could not be confirmed. For Ravni kotari the minimum estimated average territory density was 0.61–0.75 groups / 10 km². However, there was relatively high variation of local densities in different parts of the study area, with the highest numbers in the vicinity of Zadar. For Vir Island the minimum estimated territory density was 1.15 groups / 10 km². These values are relatively low compared to the results from a similar survey made in Greece.

Key words: golden jackal, *Canis aureus*, census, acoustic method, Dalmatia, Croatia

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U radu se prezentiraju preliminarni rezultati istraživanja čaglja (*Canis aureus*) u sjevernoj Dalmaciji. Da bismo utvrdili prisutnost teritorijanih skupina čagljeva, odašiljali smo snimljeno glasanje čagljeva i pratili njihov odgovor. U sjeverozapadnom dijelu Ravnih kotara zabilježeno je 19 teritorijalnih grupa čagljeva, a na otoku Viru dvije. Teritorijalni čagljevi na otoku Pagu nisu potvrđeni. Procjena minimalne prosječne teritorijalne gustoće za Ravne kotare iznosi 0.61 – 0.75 skupina / 10 km². U različitim dijelovima istraživanog područja postojala je visoka varijabilnost u gustoćama, najveća je zabilježena u blizini Zadra. Za otok Vir minimalna prosječna teritorijalna gustoća je 1.15 skupina / 10 km². Te vrijednosti su relativno niže u usporedbi s onima iz sličnog istraživanja provedenog u Grčkoj.

Ključne riječi: čagalj, *Canis aureus*, census, akustička metoda, Dalmacija, Hrvatska

INTRODUCTION

In most of Europe the golden jackal (*Canis aureus*) occurs in small and scattered populations, mainly along the coasts of the Balkan Peninsula (KRYŠTUFEK *et al.*,

1997). It is one of the least known canids in Europe and except for Greece no good data on densities exist (GIANNATOS, 2004; GIANNATOS *et al.*, 2005).

Along the Dalmatian coast a rapid expansion of the species took place in the 20th century (KRYŠTUFEK & TVRTKOVIĆ, 1990). However, except for some data on the distribution and sporadic occurrences (KRYŠTUFEK *et al.*, 1997) very limited information concerning the jackals in Dalmatia is available. In this paper we present the preliminary results from the jackal survey in Ravni kotari, on Vir Island, and Pag Island along with first the estimations of their densities in the area.

STUDY AREA AND METHODS

The survey took place in the north-western part of Ravni kotari, on Vir Island, and on Pag Island (44°00'–44°45' N, 14°45'–15°30' E) in Dalmatia, Western Croatia, between April 27 and May 5, 2007. Jackals are known to have occurred in all of these locations (KRYŠTUFEK & TVRTKOVIĆ, 1990). The study area consists of two parts: the mainland (Ravni kotari) and the islands (Pag and Vir, with area of 305 km² and 22 km², respectively). Both of the islands are connected to the mainland by bridge. The region is geologically highly heterogeneous, consisting of alternating limestone and flysch areas. Most of the area is located below 200 m a.s.l., with individual limestone ridges reaching up to over 600 m a.s.l. Several saltpans and small ponds (»blato«) are also present in the area. The climate is Mediterranean on the coast, with hot and dry summers and mild and wet winters. Inland, the climate acquires increasingly more sub-Mediterranean characteristics. Only small patches of original sub-Mediterranean forests remains today. Most of the area is covered with xeric grasslands, scrubs, and cultivated areas (RADOVIĆ *et al.*, 2005). Besides golden jackals several other carnivore species occur in the area, including two other canids – the red fox (*Vulpes vulpes*) and the grey wolf (*Canis lupus*). However, not many data about their densities are available. Wolves occur sporadically in Ravni kotari and are supposed to be absent from both islands (ŠTRBENAC, 2005). The human population density of Zadar County, which covers most of the study area, is approximately 55 residents / km².

An acoustic (play-back) method (GIANNATOS *et al.*, 2005) was used to determine the presence of territorial groups of jackals. The study area was divided into 4 by 4 km quadrates and within each quadrate one or more calling station was selected, from which a recorded group yip-howl by three to four jackals was broadcasted. The area surveyed in Ravni kotari and Vir Island is presented in Fig. 1. On Pag Island we surveyed the majority of areas with suitable habitats in the central and southern parts of the island. Calling stations were selected according to topographical characteristics in order to optimize sound transmission. We avoided sources of background noise (main roads, settlements). Field work was not done on windy and rainy nights.

Each broadcasted howl lasted for 30 seconds and was followed by a 5 minute pause. If there was no response, this set of broadcast and pause was repeated six times at each calling station, which totalled to overall session time of approximately

30 minutes. When jackals responded to the broadcast we determined the direction of the howling of the jackals using a compass. In order to avoid duplication we marked each response direction on 1:65.000 topographical maps. Geographical coordinates and altitude of locations were recorded by GPS (Garmin eTrex Summit). We also noted the time needed for jackals to respond and the number of howling jackals (single or a group). At calling stations located in open habitats we also tried to make a direct observation of jackals using night vision goggles (Dipol D212 PRO). After response we also scanned the area with a spotlight (2 000 000 candle light power). We always began the survey at least one hour after sunset and finished at least one hour before sunrise.

For the calculation of jackal territory densities we followed GIANNATOS *et al.* (2005), who determined the maximum human hearing distance on windless nights from a vantage point in an open terrain with no background noise at 1.8 to 2 km. Therefore the effective area for an audible response from jackals was estimated to be between 10.18 to 12.57 km². If sound transmission was hindered in one or more directions due to topographical features, we subtracted the corresponding share of the effective area (e.g. when we estimated that topographic obstacle hindered sound transmission to one quarter of the area, we used figure 7.64 to 9.43 km² for the calculation of effective area covered). It was assumed that only territorial groups of jackals were responding to the broadcasted howls and that each response direction coincided with a different territorial group (GIANNATOS *et al.*, 2005).

In addition, we also searched for indirect signs of jackal presence (footprints, scats, prey remains) in suitable habitats on Pag Island.

RESULTS

Jackal howling was broadcasted from 28 calling stations in Ravni kotari, 4 on Vir Island, and 5 on Pag Island. A reply was noted at 15 (41 %) calling stations. Altogether we recorded 21 territorial jackal groups: 19 in Ravni kotari and 2 on Vir Island (Fig. 1). The presence of territorial jackals on Pag Island could not be confirmed. We also failed to find any indirect signs of jackal presence on Pag Island, where we spent 3 days searching for footprints and scats.

In Ravni kotari we estimated the area covered to 254.3–312.5 km². The total number of recorded jackal groups in this area was 19, which amounts to the minimum estimate 0.61 to 0.75 jackal territories per 10 km². We noted that there was a relatively high variation in local densities of jackals, as in some parts of this area territorial jackals appeared to be absent (e.g. we recorded no response from several calling stations around towns of Poličnik, Dračevac Ninski, Briševo, D. Raštane), while in other parts several groups were recorded close to each other. The highest concentration of jackal groups was recorded in the vicinity of Zadar, especially around a cattle quarantine farm, where 4 jackal groups responded to the broadcasted howls from a single location. On Vir Island 2 jackal groups were recorded, which corresponds to a minimum estimate of 1.15 jackal territories per 10 km². Both of these two groups were located in the interior of the island.

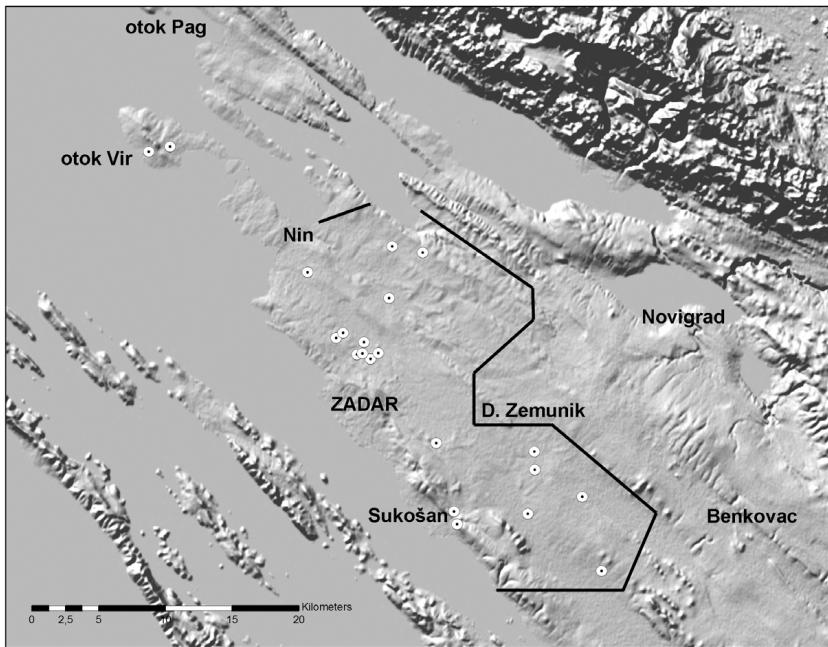


Fig. 1. Locations of recorded jackal groups in Ravni kotari and on Vir Island (n=21). Black line indicates the border of the area surveyed using acoustic method.

We also recorded the time needed for jackals to respond and the number of jackals howling. In most cases jackals responded after first (33 % of all responses) or second play-back (38 %) (Fig. 2). The latest response was noted after the fifth trial. Jackals replied significantly more quickly in cases when several territorial groups were present around the calling station (mean=8.5 min, SD=8.6), compared to when a single group was present (mean=14.1 min, SD=2.4; t-test: $p=0.03$; $n=21$). In 8 cases

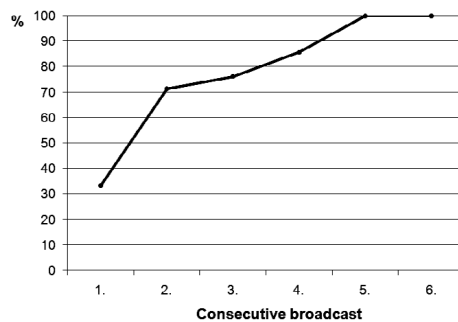


Fig. 2. Cumulative responsiveness of jackal groups that responded to broadcasted howling in Ravni kotari and Vir Island (n=21). Broadcasts were repeated every 5 minutes.

(38 %) a single jackal replied to the broadcast, and in 13 cases (62 %) several jackals were howling in response. The time needed to respond was not significantly different when one or more jackals howled (t-test: $p=0.22$; $n=21$).

Only one direct observation of a jackal was noted at the calling stations. A single jackal was observed on Vir Island after several of them responded to the broadcast. Another individual was observed from a car, when it crossed a road near Zadar in Ravni kotari.

DISCUSSION

Although there was high local variation in densities of jackal territorial groups in Ravni kotari, the average density in this area was relatively low. Somewhat higher was the estimate for Vir Island, but this too was lower than figures reported from Greece. In wetlands of Northeastern Greece jackal densities were estimated to range from 0.8 to 5 territories / 10 km² (GIANNATOS *et al.*, 2005). In most of the surveyed area throughout Greece the estimated average was 2–3 territories / 10 km² (10–15 adults + subadults / 10 km²), but local concentrations of more than 30 animals / 10 km² were recorded (GIANNATOS, 2004). Unfortunately, no other reliable estimates for the Balkan Peninsula are available for comparison. However, if we take the number of jackals seen during night driving, it seems that jackal densities on Pelješac Peninsula are much higher than in Ravni kotari and on Vir Island (1 jackal in 3 nights of night driving in Ravni kotari and Vir island compared to 6 jackals in 3 nights on Pelješac; M. Krofel, unpublished data). Also, local monitoring of spontaneous vocalization points to high group territory densities in Pelješac (KROFEL, 2006).

Although several authors have reported jackals on Pag Island since 1974 (KRYŠTUFEK & TVRTKOVIĆ, 1990; KRYŠTUFEK *et al.*, 1997; ŠERE, 2006), we could not confirm the presence of territorial groups in this area. Evidently individual jackals at least occasionally come to the island, but they are severely persecuted by local people, who fear that the jackals will do harm to their livestock. A long-lasting effort of cooperative drive hunts of several local people that subsequently resulted in a killing of a jackal in Kolansko blato in north-central part of the island was recently documented by ŠERE (2006). In spite of the relatively long time since the first recorded presence of jackals on Pag Island, it seems that their presence here should still be referred to as sporadic only. At present it is difficult to assess whether the persecution is the only reason for this, or if perhaps some additional factors are also preventing jackals from establishing permanent territorial groups on this island.

Our results confirmed observations from Greece that jackals usually reply after the first few broadcasts and that they more readily respond where jackal densities are higher (GIANNATOS *et al.*, 2005). Also the fact that in Greece jackals on average responded sooner (67 % after the first trial – GIANNATOS *et al.*, 2005) than in our study, corresponds to the hypothesis that jackals respond to broadcasted howls more readily at higher densities.

These preliminary results indicate that jackals in Ravni kotari and on Vir Island occur in relatively low densities; however, at present it is difficult to assess the en-

dangerment status. Unfortunately, it is also unknown how well this population is connected with others in Dalmatia and further inland. Additional studies are necessary to get better idea of the numbers, and, even more importantly, on the population status of the golden jackal in Dalmatia. Only after such studies are made, potentially necessary conservation measurements can be taken and perhaps some kind of control over hunting be implemented. As seems to be the case on Pag Island, human persecution, if not controlled, can have a strong impact on jackal populations.

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