

Golden jackal expansion in Europe: a case of mesopredator release triggered by continent-wide wolf persecution?

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Appendix S2 – Detailed information on presence of golden jackals and grey wolves in the eight study areas used for assessing local scale population trends

We surveyed eight study areas, where golden jackals colonised an area after grey wolf extermination, and then wolves later re-colonised the areas.

Study area 1: Central Slovenia (45°56'N, 14°20'E; size of the study area: 450 km²)

On the high-karst plateaus of Menišija and Rakitna in Northern Dinaric Mountains, a grey wolf pack was regularly present until 1952 and the last wolf was shot in the area in 1981 (P. Nared personal communication 2014). In the winter of 1952/1953 the first golden jackals appeared in the nearby lowland, the Ljubljansko barje (Mehora 1953). They disappeared the next year after two were shot and reappeared again in 1980s. In late 1980s and early 1990s jackals started to occur also on Menišija plateau, with one animal being shot at a bear feeding station in 1990 (Krže 1990) (Fig. S1). In 1996 wolves re-colonized the Menišija plateau (Nared 1998) and since then, except for two years, a territorial wolf pack was constantly present in the area. The wolf pack occasionally used the western part of the neighbouring Rakitna plateau, but never ventured far from the edges of the plateau on the Ljubljansko barje, although a lone 9-month radio-collared dispersing wolf from the south stayed there for about one month in 2008 (Ražen 2009; not shown on Fig. S1). Since 2005, wolves and jackals were intensively monitored in the area and we conducted systematic jackal howling surveys every year since 2009 (Krofel 2009). During this time, we recorded jackals on Ljubljansko barje, Planinsko polje and in the northeastern part of the Rakitna plateau (i.e. outside of the known home range of the territorial wolf pack, min. 1.5 km from the edge), but no more records of jackal presence are known from the Menišija plateau and western Rakitna plateau, after the area was re-colonised by wolves (Fig. S1).

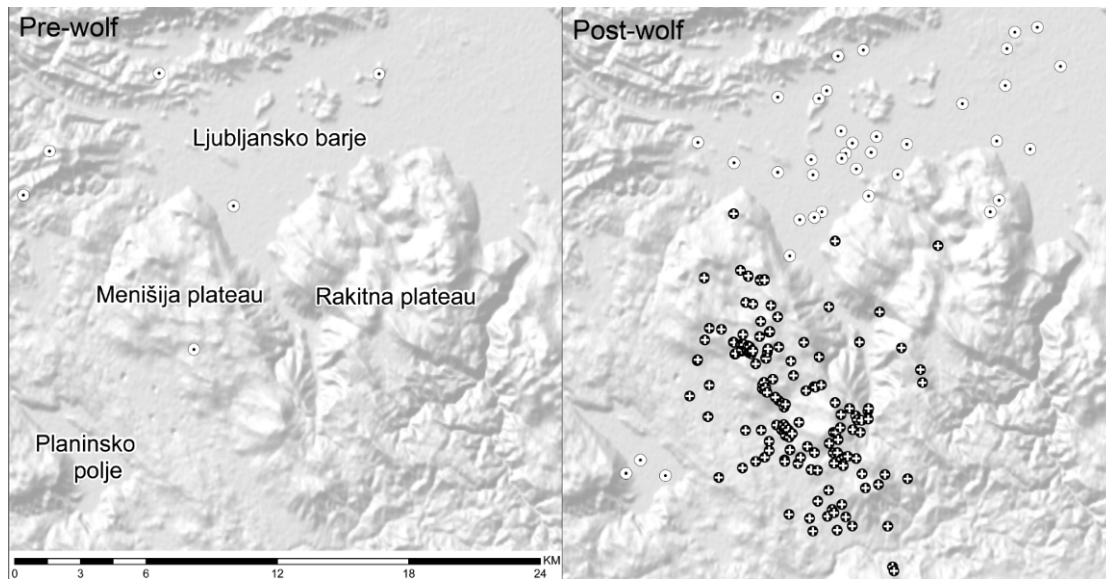


Fig. S1 Records of golden jackals (circles) and grey wolves (crosses) in central Slovenia before (left) and after (right) re-colonisation of Menišija and Rakitna plateaus by the territorial wolf pack. Records were obtained from systematic howling, snow tracking, camera trapping, searches for scats and other signs of presence, recorded mortalities and interviews with local hunters.

Study area 2: Southwestern Slovenia (45°32'N, 13°57'E; 350 km²)

The last grey wolf in southwestern Slovenia was shot in 1925. Golden jackals first appeared in the region in 1986 and in the next two decades this area (Slavnik, Kraški rob, Podgorski kras) was one of the two main centres of jackal distribution in Slovenia (Krofel 2008), and the first location with a confirmed presence of territorial jackal group in the country. Wolves started re-colonising the region in the late 1990s and the first wolf reproduction was detected in 2003. In 2010, systematic wolf monitoring was initiated in the region and until 2014 a stable wolf pack was confirmed every year and two wolves were monitored with GPS telemetry (Potočnik et al. 2014; Ražen et al. 2016). In 2015, the wolf pack disappeared and only single wolves were occasionally recorded. In 2016 a new breeding wolf pack formed in the area again. The last continuous occurrences of jackals in the area were recorded in 2007. In 2009 and 2013 we conducted systematic jackal howling surveys and no more jackals were recorded within the wolf home-range, but jackal groups were detected outside the wolf home-range (1-7 km from the edge of the wolf home-range border of the 100% minimum convex polygon). In 2015 another jackal howling survey in the region was conducted with several jackal groups recorded outside the wolf home-range and also one jackal group at the periphery of the previous wolf home-range on Podgorski kras (1 km inside of the 2012 wolf home-range from the border of the 100% minimum convex polygon).

Study area 3: Greece, Fokida province (38°23'N, 22°14'E; 210 km²)

According to the interviews with local inhabitants and game wardens, there were 1-2 territorial groups of golden jackals present in the area until 1990. According to the same people, livestock depredations by grey wolves in the area started at approximately the same time. In the late summer of 2000, we conducted a jackal howling survey and intensively searched for signs of jackal presence. No jackals were detected, but during the howling survey three wolves were spotted with a spotlight approaching the calling station from where jackal howling was broadcasted.

Study area 4: Greece, Thessaloniki province, Aliakmon delta (40°32'N, 22°38'E; 130 km²)

According to the interviews with local inhabitants and game wardens, there was at least one territorial group of golden jackals present in the area until 1990. As in the previous study area, locals described the appearance of grey wolves shortly before jackal disappearance and afterwards reported regular sightings of wolves in the area, but no more jackals. Despite intensive surveys in the area of the three river deltas in 2002 and 2015, no traces of jackal presence were found and there were no responses to broadcasted jackal howls. But at one of the calling stations a wolf was spotted with a spotlight.

Study area 5: Greece, Thessaloniki province, surroundings of lake Koronia (40°42'N, 23°08'E; 110 km²)

According to the local people and game wardens, several territorial groups of golden jackals were present in the area until approximately 1980. Since then, no reliable reports of jackal presence have been recorded. According to the same people, grey wolves were present in the area in the past, but appear to be recorded more frequently since mid-1990s. In 2001, a jackal howling survey was conducted and no jackals could be confirmed, but a territorial wolf pack responded with howling to the jackal recording and afterwards five wolves were observed with the spotlight in close proximity to the calling station.

Study area 6: Greece, Chalkidiki peninsula (40°29'N, 23°48'E; 200 km²)

In an area with previously known presence of golden jackal groups several howling surveys were conducted in 2014. Earlier that year, a local shepherd reported observing a lactating female grey wolf with three pups in the vicinity and a number of wolf attacks on small-stock farms were recorded in the area in the same period. While wolves have been known to occur in the area in the past, their observations have increased in recent years. During jackal howling survey no jackals were recorded in the area with an established wolf pack, but a jackal group was detected in the nearby area outside of the wolf home range.

Study area 7: Greece, Fokida province (38°23'N, 22°04'E; 160 km²)

Several golden jackal howling surveys conducted in the area indicated the presence of at least two territorial jackal groups until 2004/2005. According to the interviews with local shepherds, wolves started recolonising the area in 2006, with several sightings and large livestock depredations reported. The same people reported that they stopped seeing jackals in the last few years, while in the past they claimed jackals were quite common. A systematic jackal howling survey was repeated in 2015, but jackal presence was not detected.

Study area 8: Serbia, Veliko Gradište (44°45'N, 21°30'E; 137 km²)

Wolves were exterminated in the region in the 1950s and the first jackals were recorded in the beginning of the 1980s. According to interviews with local hunters and shepherds, the first wolves recolonised the area in 1991. After return, wolves were regularly shot. Throughout the 2000s wolves were regularly present in the area, but probably no stable packs existed due to intense persecution. In 2008 a pack with five wolves was formed, but the next winter three of them were shot. Jackal hunting bags increased from nine animals shot in 2001 to 67 jackal shot in 2008. We estimated jackal density with systematic howling survey in 2010 to 1.9 groups/10 km² (Heltai et al. 2013).

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