Monitoring of Conservation Status of Wolves in Slovenia during the 2017/2020 period – THIRD PARTIAL REPORT

SUMMARY

BACKGROUND

This summary reports the results from the »Spremljanje varstvenega stanja volkov v Sloveniji v letih 2017/2020« Project (Monitoring of Conservation Status of Wolves in Slovenia during the 2017/2020 period). This is the third such project financed by the Slovenian Ministry of the Environment and Spatial Planning. The methods used in the project were developed under the LIFE SloWolf project (LIFE08 NAT/ SLO/000244) and are described in detail in the Action plan for sustainable management of the wolf (*Canis lupus*) population in Slovenia for the period 2013 – 2017. This report includes the results of wolf monitoring for the season 2018/2019 and also the results of the howling survey for detection of wolf liters carried out in the season 2019/2020. The fieldwork (sample collection, tracking of occurrence and predation data) for 2018/2019 season started in May 2018 and lasted one year (until the end of April 2019), to reflect the reproductive biology of wolves. The season 2019/2020 started in May 2019 and is, at the time of writing of this report, still in progress.

METHODS

We used multiple methods including established field-based protocols, laboratory tests, and quantitative methods to provide a holistic approach to wolf population monitoring in Slovenia.

We used the **howling method for detection of wolf litters** to systematically survey the entire wolf range in Slovenia. We sampled 3 x 3 km quadrants that contain 65% or more of forest cover. In the **2018/2019 season** we surveyed 436 quadrants, or 3294 km^2. The survey was done in August 2018. Wolves were detected in 22 quadrants of which **nine quadrants included the responses of pups** that confirmed the presence of wolf litters. In the **season 2019/2020,** the **survey quadrant net was expanded** by 72 quadrants due to the expansion of the wolf population to the Alpine and pre-Alpine regions. This season the howling survey was carried out in August 2019, covering the area of 529 quadrants, or 4761 km^2. We detected wolves in 27 quadrants. **Twelve quadrants included the responses of pups.**

Field collection of noninvasive genetic samples was carried out between 1st of May 2018 and 30th April 2019. During this period, we collected 399 noninvasive genetic samples (293 scat samples, 82 urine samples, 17 saliva samples collected on natural wolf prey and 7 hair samples) of which 340 samples were genetically analyzed. This reduction was made due to the limited funds for noninvasive genetic sample analysis. Besides noninvasive genetic samples we also analyzed 5 tissue samples of dead wolves (table I; no. 2 - 6). In the final estimate of the wolf population size and social structure we also included all working genetic samples (N = 61) of wolf saliva from livestock damages (genotipisation of these was financed by Slovenia Forest Service). Based on all working genetic samples we got 243 useful wolf genotypes (177 from noninvasive genetic samples, 5 from dead wolves' tissues, 61 from livestock damages) for the mark-recapture and kinship analysis.

Table I: Dead wolves, inspected in the period from 1. 5. 2018 to 30. 6. 2019

No.	LUO	Hunting ground	Date	Sex	Body weight (kg)	Age estimate	Type of mortality	Notes
1	Notranjsko	Kozlek	20.05.2018	F	22,0	1+	legal cull	
2	Notranjsko	LPN Jelen	19.07.2018	M	3,4	0+	loss	natural
3	Kočevsko-Belokranjsko	Predgrad	16.10.2018	F	21,5	0+	loss	Roadkil
4	Notranjsko	Prestranek	30.10.2018	F	23,0	0+	loss	unknown
5	Notranjsko	Prestranek	15.11.2018	M	46,0	5+	loss	roadkill
6	Notranjsko	Rakek	14.05.2019	M	/	1+	loss	roadkill

RESULTS

There are some **changes in the spatial picture of the population** compared to the sampling in the previous season (Figure I). For the season 2018/2019, we estimate that there are **14 wolf packs in Slovenia, 6 of which we share with Croatia**. Eight wolf packs (of which one is wolf- domestic dog hybrid pack) were assessed as vital, three had "emerging" status and three "unknown status". In addition, we have 16 wolves outside the territories of confirmed packs (four immigrants of unknown pedigree, one descendant of the wolf Slavc from near Verona, Italy, and 11 dispersers with known pedigree). Out of these 16 wolves, there are three male-female pairs sharing the same space and we have confirmation of reproduction in the 2019/2020 monitoring season. Unless the mortality of the reproductive specimen is recorded, it is expected that these three couples will receive “emerging” wolf pack status in the next season. For the female in the Menina Planina area, crossbreeding with domestic dog and a litter of hybrid puppies were confirmed in the summer of 2019.

This season, as mentioned in the paragraph above, there are 16 wolves outside the territories of confirmed packs which is significantly more then in the previous seasons. Eight of these are immigrants to our population. For two of these immigrants we have a genotype of their father, a wolf from the Croatian population. At least one immigrant comes from the Italian Alps and is descendant of the wolf Slavc who dispersed from Slovenia to Italy (vicinity of Verona) where he formed a pack. The mentioned italian immigrant wolf settled on Pokljuka plateau with female wolf of unkonown origin.

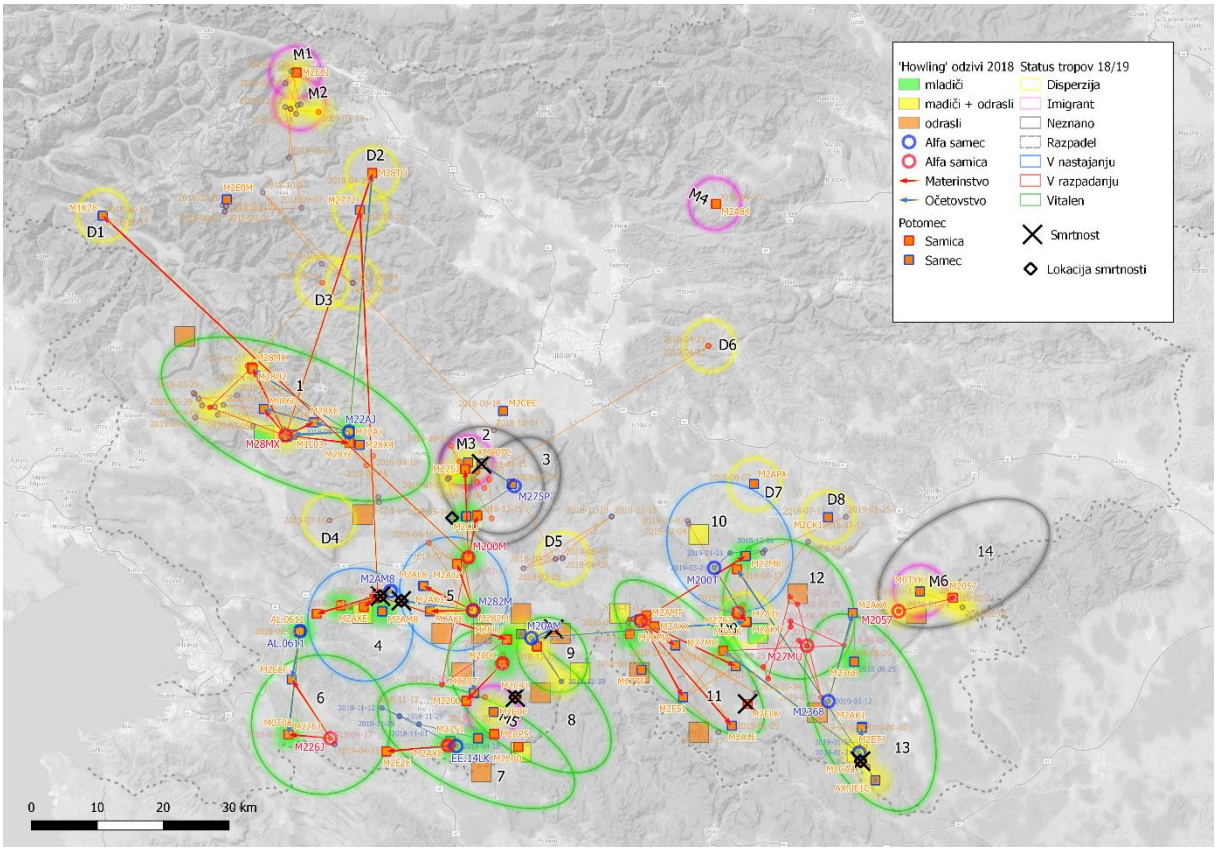

Figure I: Family connections (pedigree) of wolves in the sampling season 2018/19, presumed pack territories, howling 2018 test results and tagged dispersers / immigrants. Pack territories are made on the basis of the locations of members of each pack, but are of a purely indicative nature.

This season **the population size estimate** is slightly less accurate than in the season 2017/2018. The population size estimate for the season 2018/2019 has a wider confidence interval compared to the previous season. Besides that there is a significantly higher difference between the number of "cought" animals and estimated population size obtained by capture-recapture method than in the previous seasons. In 2018/2019, sampling was relatively less intensive as well as more spatialy homogenous. Because of that there is a noticable capture heterogenity. When capture heterogenity is high, there is a possibility of systematic error in the capture- recapture population size estimates. Eventhough we used different models that take capture heterogenity into account and these models produced almost identical results, **we advise to use this season results more carfully than the results from the previous seasons**. Given the larger discrepancy between estimated population size and number of "cought" (detected) animals than in the previous years, **it si possible that the population size is slightly overestimated**. However, we can say with certainty that the number of wolves in the Slovenian popualtion is clearly increasing.

The entire superpopulation, including all wolves detected in transboundary packs, was estimated at around 113 individuals (102–130, 95% confidence interval) but through the genotypes we detected 83 unique individual wolves. Considering the superpopulation estimate, this would mean that 30 individuals were not detected which is the highest proportion of undetected animals so far. Through the reconstruction of the pedigrees, we have identified 14 wolf packs, 6 of which are transboundary. There are also 16 wolves in the population that are outside the territories of the confirmed packs which is significantly more than in the previous years. Since the estimated average size of the wolf pack in

Slovenia is around 5 wolves, and since only two of the immigrants are close to the border with Croatia, these wolves will be considered as three additional packs, which are entirely in Slovenia for the purposes of correction of the cross-border migration. From the final calculation we excluded the Gorjanci pack, since it has most likey fallen apart, because we detected just a few animals in that area. According to the methodology from the previous years, 5/16 (31.2%) of the population are considered as cross-border animals. In accordance with the previous years' practice, half of the estimated cross-border animals are subtracted from the estimated population for management purposes. Thus, **in the season 2018/2019, we have 95 (86-110) wolves for management purposes (after correction for cross-border animals) in Slovenia.**

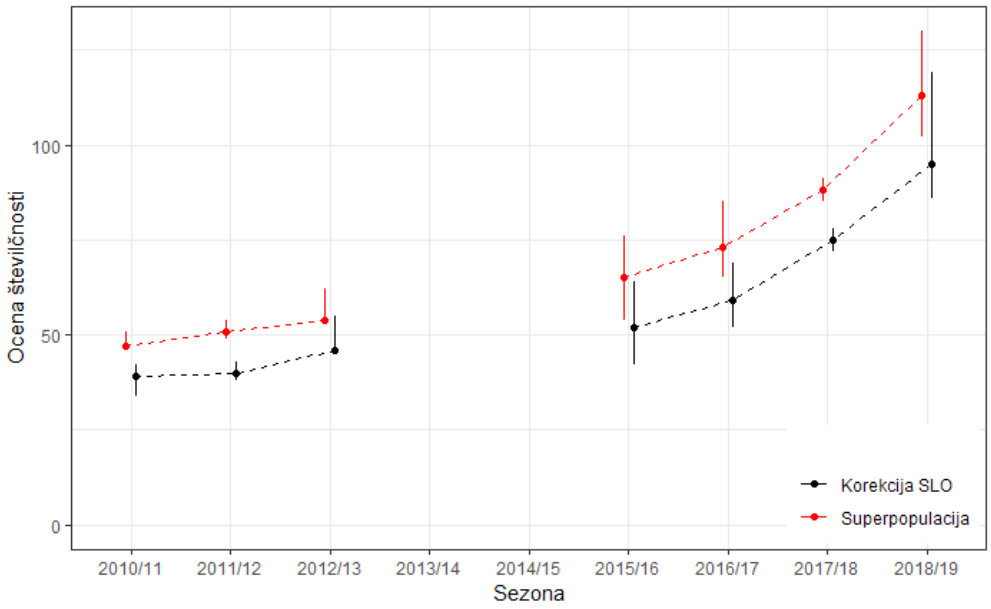

Figure II: Multi-year dynamics of the wolf population in Slovenia. The points are mean population size estimaets, the vertical lines indicate a 95% confidence interval. Due to the considerable catch heterogenity, the estimate for the season 2018/2019 is slightly lower and the population size may be slightly overestimated.

In the last decade, the wolf population in Slovenia has increased significantly. It seems that wolf abundance in Slovenia is now at the point where chance and mortality of each individual are becoming less important for defining the species conservation status.The wolf population shows a constant positive dynamic in both abundance and spatial characteristics, as it has been increasing and expanding spatially since 2010, ever since we have quality monitoring data**. As a result, we define the conservation status of the wolf in Slovenia as favorable.** For some time, this has been the case in the Dinaric part, where the vacant territories fill up very quickly, mostly with the descendants of the surrounding packs or individuals from elsewhere. Last season, the situation also changed significantly in the Alpine part of the wolf presence area.

Considering this season, the most important developments are certainly in the Alpine and pre-Alpine regions. The pack in the Trnovski gozd, has occupied that area for many years. Since the beginning of the wolf monitoring in Slovenia, we detected some individuals from this pack that dispersed further in to the Alps. In the season 2018/2019, besides Trnovski gozd pack we detected the designs of three packs further north: in Cerkno region, on Jelovica plateau and on Pokljuka plateau. Because of that it is expected that the dynamics of wolf spread in the Alps will accelerate significantly. In the previous

season 2017/2018, we confirmed the first wolf from the Alpine population, a descendant of the wolf Slavc, who made the journey in the opposite direction from his father, then was killed by a train near Logatec. This season, another descendant of Slavc appeared, who, along with a female of unknown origin, formed a territory in Pokljuka. It seems that the contact between Alpine and Dinaric population is established, and wolves now come not only from the Dinarides but also from the Italian Alps to the Slovenian Alpine and pre-Alpine regions.

Due to recurent sampling, we can continue to monitor population dynamics. Because of differences in sampling intensity some estimators in the table II can be over or underestimated, nevertheless we get the overall picture of the population dynamics. The population shows remarkable dynamics that have been recorded since 2010.

Table II: Population dynamics table. Estimates are based on the actual detected animals, not model abundance. Based on the reconstructed pedigress, we divided the total population growth into reproduction and immigration. As the catch probability of the animals was lower in the season 2016/2017, the population growth estimate is slightly overestimated. For the same reason, the increase in estimates for the season 2017/2018 is also slightly overestimated. As sampling was less intense relative to the larger population in 2018/2019, population growth is underestimated and losses are overestimated.

Above diagonal: number of animals from season Y cought again in season X

Season X / Season Y	15/16	16/17	17/18	18/19	Total animals	Loss	Growth	Imigration	Reproduction
15/16	49	15	13	7	49	-	-	-	-
16/17	3	47	31	16	65	30 (61.2%)	47 (95.9%)	4 (8.5%)	43 (91.5%)
17/18	1	2	52	37	87	32 (49.2%)	52 (80%)	3 (5.8%)	49 (94.2%)
18/19	0	0	1	44	83	49 (56.3%)	44 (50.6%)	8 (18.2%)	36 (81.8%)
Missed in X	4	4	2	1	Diagonal: N first catch				

Under diagonal: number of animals from the season X that were not cought in the season Y; but were cought later.

The problem of crossbreeding between wolf and dog remains a concern. We are still recording territorial crossbreed animals and reproduction, which presents a significantly bigger problem for wolf conservation than single crossbreeds - dispersers. The crossbreed pack Kozarišče remains vital, and one of the offspring is also detected in the dispersion. We have also confirmed a direct crossbreeding for the first time, in the summer of 2019 we found a litter of first generation wolf dog hybrid pups on Menina Planina. We advise that **for the long-term conservation of Slovenian wolf population it is best to remove all known wolf-domestic dog hybrids** from population. Due to the expansion of the wolf population in the Italian Alps to the east, dispersing animals from Italy are increasingly occurring in our country. Wolves from the Italian Alps are genetically slightly different from the Dinaric wolves, so they could be mistaken for crossbreeds. We will solve this methodological problem shortly, but for the time being we are more cautious in the definitions of some other suspected animals.

CONCLUDING REMARKS

In the season 2018/2019, sampling success was lower than in the season 2017/2018 –mostly because of chance, but also because the population has increased and current funds are no longer sufficient to

analyse a sufficient number of samples, leaving some samples unanalysed. **Nevertheless, the results are acceptable, but because of a lower sampling success we need to be a little more careful when interpreting this results than in the previous years.** Given the larger discrepancy between the estimated population size and the number of detected specimens**, it is possible that the population size is slightly overestimated.** At this point we can stress out that we know the Slovenian wolves on a "personal" level for many generations and that we understand their social structure, abundance and long-term population dynamics in detail. Because of that we have all the data for cutting edge, science-based management of this charismatic large carnivore species in our country.

Certainly the most important development of this season is happening in the Alpine and pre-Alpine world. Wolves in the Alps are clearly becoming a constant, and the colonization process from the Dinarides is joined by the colonization from the west in the direction of the Italian Alps. A key challenge in the coming years will be to find solutions for coexistence - to dispel myths about the dangers of the wolves and to directly help people who are directly materially affected by the presence of the wolves. However, the problem that we will have to deal with seriously is wolf-domestic dog crossbreeding. Although this phenomenon is not as serious as in some other countries, the issue must be taken seriously.

In any case, the conservation status of the wolves in Slovenia can again be defined as favorable. Because we have been monitoring the growth and spatial expansion of the population since 2010, we can firmly argue to this case.

However, it should be remembered that the total number of wolves in Slovenia is by far too small for the long-term viable population, so it is crucial to maintain connectivity with other Dinaric wolves in Croatia and Bosnia and Herzegovina in order to maintain a favorable conservation status. In this sense, we should not forget about the fences at the border with Croatia and make sure that they do not cause isolation of the "edge" populations of large mammals in Slovenia.