

The Visitor Flows and the Bird Communities in the Paklenica National Park, Croatia (between 1997-2001)

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Abstract: The paper shows the visitor flow in the Great Paklenica canyon, the most visited part of Paklenica National Park. This area is the greatest climbing center in Croatia. About 500-800 visitors reside on average in this area daily from mid-April to the end of October. The maximum number of visitors, 90.000, was reached in 2001. Up until now we have noted more than 200 bird species the National Park area, and between 1997 and 2001 we have recorded 56 species breed in the Velika Paklenica canyon. This most visited canyon, is known as the breeding area of 18 rocky bird species, such as as Peregrine Falcon, Short-toed Eagle, Kestrel, Rock Partridge, Eagle owl, Rock Dove, Alpine swift, Raven, Rock Nuthach, Blue Rock Thrush, Rock Thrush, Crag Martin, House Martin, Red-rumped Swallow, Black Redstart, Black-eared Wheatear. One pair of Golden Eagles moved to an inaccessible area of the Mala Paklenica canyon. The small colonies of Griffon Vultures have ceased to exist in the National Park. The Egyptian Vulture have disappeared from Croatia at the end of the 1980-ties. This paper discusses the influences of visitor flows, climbing and other recreational activities on the breeding bird communities.

INTRODUCTION

The area of the Paklenica National Park covers 96.000 ha in the southern part of the Velebit mountain (fig. 1). Confined between the sea coast and the central ridge of the mountain chain it comprises two canyons, Velika and Mala Paklenica and the surrounding southern foothills with the native Black Pine (*Pinus nigra*) and Beech woods (*Fagus sylvatica*). Because of its exceptional natural beauties of limestone Karst, its geological formation, large and old virgine forests rare on southern slopes of Mediterranean mountains, it was proclaimed the second Croatian National Park in 1949. The entire Velebit Mountain was recognized by the United Nations in 1978 as a part of the international network of Biosphere Reserves. Formed mostly of limestone and dolomite, Mountain Velebit emerges 145 km along the Adriatic coast as a 10-30 km wide natural barrier toward the continental interior with the highest peak Vaganski vrh at 1757 m altitude. The southwestern (seaside) rocky slopes are influenced by the Mediterranean climate, while in the interior the subalpine and continental climate prevails on the highest peaks and northeastern (continental) slopes. The ornithofauna of this area was mentioned in a number of published papers (Maštrović, 1942; Rucner, D., 1963; Rucner, R., 1967; Škornik, 1987; Lissak, 1990; Lukač et al. 1992; Lukač & Karadžić, 1993; Lukač & Stipčević, 1997; Lukač, 1999), as well as in numerous popular publications. The paper intends to show the impact of visitors, hikers

and climbers on the ornithofauna of breeding birds of the Velika Paklenica canyon. This type of research has never been carried out in Croatia. The measurement for the comparison of the impact of the number of visitors was the abundance of the couples during the research between 1997 and 2001. In this period the number of visitors, hikers and climbers increased constantly. The Shannon-Wiener diversity index was calculated (Krebs 1985, 1999, 2000) on the basis of the collected data.

METHODS

Investigated area

The Velika and Mala Paklenica canyons penetrate 14 and 12,5 km into the southern slopes of the Velebit Mountain directly from the seacoast to the deep interior in the foothills of the highest mountain ridge. The ridges of both sides are about 700m. Permanent springs from the interior flow through the canyons as temporal streams after snowmelt or heavy rain. Such a specific geographical position of the National Park and the encounter of very different climate types have formed specific ecological conditions. Rich and varied petrophilic wildlife and vegetation with many endemic and relic species characterize both canyons (Lukač & Stipčević, 1997; Lukač, 1999). The geological structure of the area of the national park is unique for its Paleozoic sediments of Permian age in the Dolomite-limestones make up (Božičević, 1995). The climate of southern Velebit is transitional between continental and maritime, and the thermal effect of the Adriatic is limited to a

narrow zone on the south-west slopes, up to a Mediterranean influence penetrates deeply into the interior of Mount Velebit through the Mala and the Velika Paklenica canyons. In return, alpine and continental climatic conditions drop down to the very entrances of both the canyons. The relief has a very considerable effect on air, temperature, insolation and precipitation. Thus, the annual precipitation on the Vaganski vrh (1757 m altitude) and the Sveto Brdo peaks (1753 m), comes to about 3500 mm. The whole of the area of southern Velebit features Mediterranean rainfall characteristics, with maximum precipitation in the colder half of the year (Perica, 1994; Perica & Orešić, 1995). Of winds, mention should be made of the north easterly, or *bora*, a cold gusty and dry wind that blows longer and harder in the winter. The origin of the *bora* is to be found in the influx of cold northern air masses that pile up on coming to the relatively high and broad barrier of Velebit in the depression of the Lika polje. Rising, the wind simply overflows towards the sea, most strongly in the southernmost and lowest passes, such as Vratnik, Baške Oštarije, Mali Alan and Prezid. With this overflow of air, in a pseudoadiabatic process, just above the ridge of Velebit, a white mass of clouds is formed. Of the maritime winds, the most important is the *scirocco*, here called the *yugo*, which is formed from the inflow of warm air from the south and its passage across the Mediterranean and the Adriatic. On its way the air becomes saturated, and, as it rises over the Dinaric Alps, its temperature falls, which is accompanied by a rise in relative humidity, cloud cover and rainfall. In summer the *maestral* often blows, a typical westerly or north-westerly. About 55% the National Park area is covered, and 45% is rocky area, without vegetation which has formed karst relief. The covered area consists of largely forests of European Beech *Fagus sylvatica* (52%), Black Pine *Pinus nigra* (20%), mixed forests of European Beech and Black Pine (8%), Downy oak *Quercus pubescens*, Eastern Hornbeam *Carpinus orientalis*, European Hop Hornbeam *Ostrya carpinifolia* (9%). The upper tree-limit of mountain is marked by belt of Mountain Pine *Pinus mughho* (4%). Other important habitats are upland meadows and pastures (7%).

Field investigations

The bird fauna of the Croatian National Park "Paklenica" was investigated in two periods. During the first period of 297 field days 193 birds species were recorded. In the second period of 664 field days other 16 species were recorded in the area of National Park and its surroundings (Lukač & Stipčević, 1997). Field work was concentrated on the inside borders of the National Park (NP), especially in the Velika Paklenica canyon since it represents the main phenomenon on NP. The birds

height of about 700 or 800 m, but the were observed in the field in the Velika Paklenica canyon along the main tourist path, and the transect



Figure 1. Croatia in Southeast Europe and Paklenica National Park in Dalmatia and in South part of Velebit.

for establishing the bird pairs encompassed 8500m in length and 50 m in width. All petrophile species were recorded outside the said width and at visible rocks on both sides of the canyon. The pairs were counted on the basis of singing males and found nests (Cody, 1985; Bibby at al. 1992; Flade, 1994; Hochrathner, 1995). The abundance of 56 nesting bird species, 18 of which were petrophile species, was analysed. The Shannon-Wiener diversity index was calculated as a measure for defining the abundance and the variety of the bird community (Krebs, 1985, 1999, 2000). The major part of the research was carried out in the nesting season during 41 field days in the period from the end of April to the first decade of July 1997-2001. The number of visitors was counted at the entrance reception. The most visited area in the Velika Paklenica canyon extends from the reception to the Manita cave, the Foresters' house and the Mountaineerhouse (altitude from 30-550m). The highest number of visitors per year occurred in the period from mid-April to the end of October. The visitors were recorded in the visitors' book and on the basis of the reported entrances and the sold tickets. The climbers were counted on the basis of registrations and sold entrance tickets. The visitors in the Manita Peć cave were also counted on the basis of the entrances registered with the guide. All free entrance visitors were also recorded as repeated entrances into the Park. The abundance of visitors was established for the period 1998-2001. Today there are 500 climbing directions in the Velika

Paklenica canyon, while the Mala Paklenica canyon is the no-climbing zone.

RESULTS

The Velika Paklenica canyon bird community

The total of 56 species of nesting birds were recorded. The petrophile ornithofauna consists of 18 species. The abundance of the species and pairs in individual years of the research is best seen on Table 1. Of all petrophilous species the most abundant was the colonial species *Apus melba* with 15-35 pairs. The same is also true for *Columba livia*. The *Sitta neumayer* species has shown constant abundance of 7-10 pairs throughout the researched period. Generally during the research period no significant changes in the abundance of songbirds (*Monticola solitarius*, *M. saxatilis*, *Oenanthe hispanica*, *Phoenicurus ochruros*, *Hirundo rupestris*, *Delichon urbica*) were noticed.

The Extinct Species

The last observation of the *Neophron percnopterus* was recorded in May of 1987. Since then this species was not recorded in the Paklenica NP. Also this type of vulture is disappearing from the entire Croatia. The last time the Eurasian vulture nested in the NP was in 1999. This is due to the campaign of poisoning the wolfs, jackal and stray dogs in the areas close to the NP where the vultures used to feed. At the end of 1997. 12 to 14 specimens of the Eurasian vultures from Paklenica. The campaigns to ban climbing on the rocks where the vultures and peregrine falcon nest proved to be successful in 1997, 1998, and in 1999. In those years the birds succeeded in breeding the hatchlings. Permanent ban on climbing in the Mala Paklenica canyon has secured undisturbed life for the bird community of rocks and cliffs (Tab.2).

Visitors and climbers

The greatest number of visitors was recorded in the Velika Paklenica canyon, and particularly in the part between the entrance reception and the Mountaineers' house (total length of 8,500 meters). The Manita Peć cave was visited by over 15,000 visitors, the Forester's house and the Mounteneers' house by about 53,000 visitors. The abundance of visitors by years is visible from tables 4. The number of climbers increased every year. The highest abundance was recorded around Easter and during the big –wall climbing competition on 1st May 2000 and 2001. Mountaineering/Rock-climbing has a long tradition in the Velika Paklenica area. Since 1938 over 500 directions have been set up.

Year	Number of species	Number of pairs
1997	38 (16)	272 (108)
1998	33 (14)	202 (106)
1999	40 (16)	300 (128)
2000	34 (13)	234 (100)
2001	40 (13)	303 (135)

Table 1. The number of species and pairs of nesting birds in the Velika Paklenica canyon. Petrophile species in ().

Year	V.Paklenica	M. Paklenica	Total
1996	5	2	7
1997	2	5	7
1998	1	0	1
1999	3	0	3
2000	0	0	0

Table 2. Number of pairs of Eurasian Vultures.

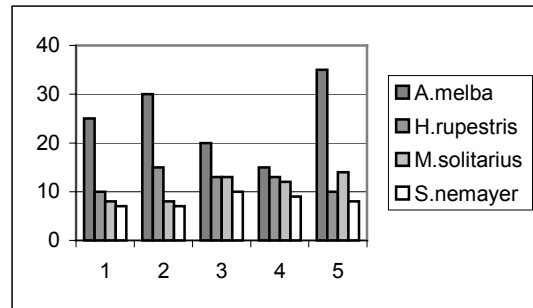


Figure 2. The number of pairs of four petrophilous species between 1997-2001.

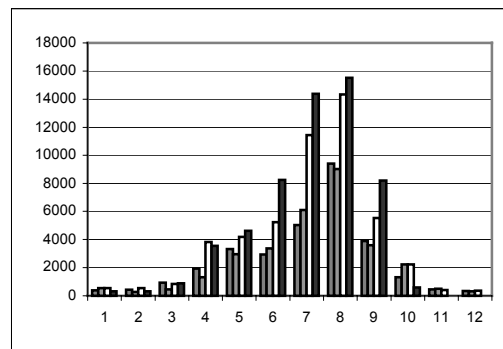


Figure 3. Number of walkers per months from 1998- 2001 in Velika Paklenica canyon.

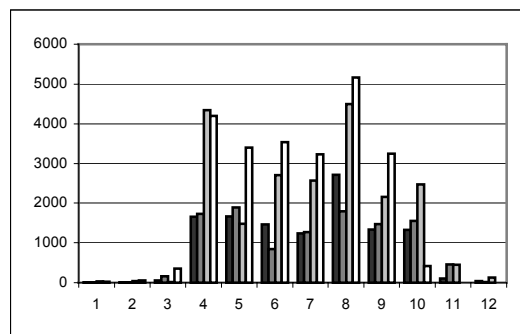


Figure 4. Number of climbers per months from 1998- 2001 in Velika Paklenica canyon.

Bans and regulation of climbing activities

The bans for the climbers and the regulation of climbing is also applied with the *Falco peregrinus* species as it permanently nests in Velika Paklenica since 1997-2001. The *Aquila chrysaetos* species, on the other hand, has not nested since 1992 in the Velika Paklenica canyon, and its single pair moved to the inaccessible original parts of Mala Paklenica., where the visitors' frequency is much lower. During the autumn of 2001 two pairs of the *Bubo bubo* species were noted to be moving from the areas close to the climbing paths in the Velika Paklenica canyon to the parts of the canyon where there are no such activities nor climbing paths. Only 2-4 pairs have remained here. Only *Corvus corax* did not nest during the last three years in the parts of the canyon where the rock-climbing activities take place. During the research (1997-2001) the greatest changes occurred in the abundance of the raptors. Thus the *Circus gallicus*, which nests in the canyon occasionally, nested in 2000 and 2001, but not in 1997, 1998, and 1999. The increase in the number of visitors has influenced the withdrawal of the *Alectoris graeca* species towards the less accessible areas of the Park. The falling abundance of this species, can be explained by other reasons, such as overhunting, the use of pesticides, increased numbers of foxes, etc. The comparison of the Shannon-Winer's diversity index (H) shows a slow decrease of the values since 1997 (Table 3).

Years	H
1997	4,223
1998	4,048
1999	4,218
2000	4,182
2001	4,133

Table 3. Shannon-Wiener indeks diversity.

Years	1998	1999	2000	2001
Months				
I	401	564	575	337
II	453	280	600	372
III	1000	617	863	1251
IV	3595	3058	8158	7746
V	4974	4831	5659	8021
VI	4377	4198	7944	11779
VII	6267	7376	14014	17621
VIII	12126	10812	18833	20671
IX	5219	5063	7688	11456
X	2646	3762	4679	1020
XI	558	962	866	-
XII	383	328	484	-
Total	41999	41581	70363	80274

Table 4. Number of visitors in Velika Paklenica canyon from 1998-2001.

DISCUSSION

The research of the nesting birds in the period 1997-2001 resulted in 56 recorded bird species. Of all those 18 species account for the rock type of ornithofauna (Table 5). The study of the abundance of some species of nesting birds in the Velika

Paklenica canyon with the increased number of visitors and particularly the increasing number of climbers has a direct impact on some sensitive species. This is particularly true of *Bubo bubo* (Mebs & Scherzinger, 2000), or *Tetrao urogallus*, *Lyrurus tetrax* in some part of Europe (Holzhausen, 1995; Klaus, 1995; Klaus & Augst, 1995; Marti, 1995; Schmalzer, 1995; Suchant, 1995). The abundance of this species can be reduced by as much as 50% due to the direct influence of the climbers. Our research has shown that the abundance did not drop, but that 2 pairs moved into the parts of the NP where there are no rock-climbing paths or climbing activities during the spring and summer of 2001. In the autumn the rocks are frequented by 3-4 pairs. The *Corvus corax* is another sensitive species which nests on the rocks and cliffs in the protected parts of the canyons away from the climbing paths. The most recent sighting of the third sensitive species, *Alectoris graeca*, was in 1997, not far from the reception. The increase of the number of visitors influenced its withdrawal towards the unaccessible parts of the Park. It has already been emphasised that the fourth withdrawing species *Aquila chrysaetos* has not nested since 1992 in the nest situated on a rock in Velika Paklenica and outside the climbing paths. It was regularly registered in the unaccessible parts of Mala Paklenica, where the number of visitors is much lower. Only *Falco peregrinus* nested every year between 1997 and 2001 in the middle of the recreational area on the rocks with or without the established climbing paths, which points to the fact that this pair did not mind the increased number of climbers and visitors. Due to all above said we have undertaken steps towards banning climbing on the paths near the nests, and the climbers are regularly advised of this by oral or written information in order to protect the endangered species in the best possible ways. The last time *Neophron percnopterus* was spotted in Croatia in 1987, and this happened in Velika Paklenica. The activities connected with the poisoning, the reducing the number of cattle, and the hunters' shooting the predator birds resulted in the reduced number of abundance and even extinction and disappearance of raptors from Croatia. One of the most endangered species nesting in Croatia with about 80 pairs (Lukač, 1998), Eurasian vulture (*Gyps fulvus*), is disappearing from the NP at the end of 1999 (Lukač & Stipčević, 1997; Lukač, 1999, 2000). Until then 8 to 10 pairs nested in the Park, which accounted for as much as 10% of the total Croatia's population (Lukač & Stipčević, 1997). Following the fall in the abundance in November 1997 when 6-7 pairs disappeared from Mala Paklenica which was preserved from climbing activities. In the course of the following two years griffon nested successfully in Velika Paklenica. In 1998 1 pair nested, while in 1999 3 pairs were recorded nesting (Table 2). All pairs brought up their siblings which left the nests in mid-August. Owing to constant

information service for climbers and climbing bans on the paths in close vicinity of the nests in 1997, 1998, 1999 good protection of this species was realized in this period. In 1998 the first feeding site was founded, and permanent information in the media raised the public awareness of the importance of this vulture species. Unfortunately, the poisonings in the Park surroundings led to the disappearance of this species from the Paklenica National Park in 2000 (Lukač, 2000). Since then nesting has stopped in the Park, and the sightings of griffons were sporadic, most often in September and in October while the young birds overflow from the Kvarner area. They usually fly in small flocks of 2-8 birds on their way from Kvarner to southeastern Europe or northern Africa. Today, quite rightly, the griffon has become one of the most endangered species of raptor birds in Croatia, and the Park's Administration is trying to carry out the projects of resettling of this species. Other rock species (*Columba livia*, *Apus melba*, *Hirundo rupestris*, *Delichon urbica*, *Monticola saxatilis*, *M. solitarius*, *Sitta nemayer*, *Oenanthe hispanica*, *Phoenicurus ochruros*) did not significantly change their pairs' abundance, which leads to the conclusion that rock climbing and visits did not prove to be harmful for these species. The comparison of the values by individual years resulting from the Shannon-Wiener index, a slight decline of the value can be noted. Therefore it is proposed to continue the following of the rock ornithofauna with the aim of undertaking the appropriate protection measures for this interesting type of ornithofauna. The education of the climbers and all visitors has resulted in good results, and climbing bans in particular paths are observed, especially with reference to the protection of the rare and endangered bird species.

CONCLUSION

From 1997 to 2001 the number of visitors to the Paklenica National Park increased from 40,000 to almost 90,000. The total of 56 nesting birds, 18 of them petrophile species, were spotted in the Velika Paklenica canyon. The greatest impact of climbers was noticed with the *Bubo bubo*, *Alectoris graeca*, *Aquila chrysaetos* and *Corvus corax* species. The *Falco peregrinus* has nested constantly in the Velika Paklenica canyon since 1997. The measures that banned climbing proved to be successful in protecting the griffon, peregrine falcon and short-toad eagle. Due to an increased number of climbers *B. bubo* moved to the less frequented parts of the canyon. The same is true for the *C. corax* species. Only *A. chrysaetos* and *A. graeca* moved to the parts of the Park where the number is significantly lower. We propose that the Mala Paklenica canyon continue to be the climbing ban zone, and that the visits be constrained to small groups and exclusively accompanied by a guide. This part of the Park offers excellent opportunities for

birdwatching of the petrophile types of bird communities.

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APPENDIX

Table 5. The 56 recorded nesting birds species in the period 1997-2001 in Velika Paklenica canyon. Of all those 18 species account for the rock type of ornithofauna.

Years of investigations	1997	1998	1999	2000	2001
Species Number of species per year	38	33	40	34	40
1. <i>Luscinia megarhynchos</i>	48	30	40	35	47
2. <i>Sylvia atricapilla</i>	24	19	45	31	41
3. <i>Apus melba</i>	25	30	20	15	35
4. <i>Columba livia</i>	27	25	30	18	35
5. <i>Fringilla coelebs</i>	11	9	20	14	18
6. <i>Turdus merula</i>	19	9	28	22	18
7. <i>Delichon urbica</i>	7	6	18	15	16
8. <i>Monticola solitarius</i>	8	8	13	12	14
9. <i>Hirundo rupestris</i>	10	15	13	13	10
10. <i>Sitta neumayer</i>	7	7	10	9	8
11. <i>Motacilla cinerea</i>	3	5	5	5	6
12. <i>Oriolus oriolus</i>	2	1	6	5	6
13. <i>Parus palustris</i>	2	3	1	2	5
14. <i>Phoenicurus ochruros</i>	4	2	3	4	4
15. <i>Phylloscopus collybita</i>	7	4	3	1	3
16. <i>Parus major</i>	2	2	4	3	3
17. <i>Parus caeruleus</i>	0	3	4	1	3
18. <i>Sylvia melanocephala</i>	1	0	0	0	2
19. <i>Sylvia cantillans</i>	4	2	3	1	2
20. <i>Falco tinnunculus</i>	2	3	2	2	2
21. <i>Erithacus rubecula</i>	0	2	2	1	2
22. <i>Cinclus cinclus</i>	1	2	2	2	2
23. <i>Coccothraustes coccothraustes</i>	1	1	2	0	2
24. <i>Corvus corax</i>	2	1	2	1	2
25. <i>Lanius collurio</i>	3	0	1	2	2
26. <i>Sylvia hortensis</i>	3	0	1	1	1
27. <i>Picus canus</i>	0	1	0	0	1
28. <i>Sitta europaea</i>	0	1	2	4	1
29. <i>Cuculus canorus</i>	1	0	0	1	1
30. <i>Streptopelia turtur</i>	0	0	0	0	1
31. <i>Garrulus glandarius</i>	1	0	1	0	1
32. <i>Troglodytes troglodytes</i>	0	1	0	0	1
33. <i>Emberiza cirrus</i>	0	0	0	0	1
34. <i>Falco peregrinus</i>	1	1	1	1	1
35. <i>Serinus serinus</i>	0	0	0	0	1
36. <i>Parus ater</i>	1	0	0	0	1
37. <i>Picoides minor</i>	0	1	0	0	1
38. <i>Circaetus gallicus</i>	0	0	0	1	1
39. <i>Aegithalos caudatus</i>	3	0	1	2	1
40. <i>Emberiza cia</i>	1	1	1	0	1
41. <i>Oenanthe hispanica</i>	6	0	4	4	0
42. <i>Carduelis carduelis</i>	0	0	0	3	0
43. <i>Muscicapa striata</i>	1	1	1	1	0
44. <i>Sylvia curruca</i>	1	0	1	1	0
45. <i>Otus scops</i>	0	0	0	1	0
46. <i>Gyps fulvus</i>	3	1	3	0	0
47. <i>Bubo bubo</i>	0	1	2	0	0
48. <i>Accipiter nisus</i>	0	0	1	0	0
49. <i>Monticola saxatilis</i>	1	0	1	0	0
50. <i>Picoides major</i>	0	0	1	0	0
51. <i>Carduelis chloris</i>	0	0	1	0	0
52. <i>Acanthis cannabina</i>	0	0	1	0	0
53. <i>Picoides leucotos</i>	0	1	0	0	0
54. <i>Columba plauzeus</i>	1	0	0	0	0
55. <i>Jynx torquilla</i>	1	0	0	0	0
56. <i>Alectoris graeca</i>	1	0	0	0	0
TOTAL	272	202	300	234	303