

## OPWALL Krka National Park, Croatia, 2019, after season evaluation

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#### 1. Transects and survey sites

Except for the first 1000m from the first sample route or transect (T), six sample routes with survey sites (SS) were newly created from scratch. Sample route creation was labor intensive and involved substantial time in the beginning of the season. Sample routes were completed 4 July 2019. An overview with description of the transects is presented in Appendix 1.

All transects except for T1 and T6 are within the boundaries of Krka NP. The need for some easy accessible transects (both are on the plateau) close to the research station and a fair representation of mature oak forests warrant keeping these transects in the surveys.

The sample routes were chosen to include representative habitat types in the landscape including:

1. Juniper dominated grasslands (with subcategories: recently burned, rocky slope, mature).
2. Oak-hornbeam dominated forest on the plateau. Oak forests are all relatively young, no old large oaks are present.
3. Hornbeam dominated forests close to Krka river.

Originally the plan was to include pastoral areas (actively grazed meadows and recent agricultural land) but these overlapped substantially with the Juniper grasslands and/or more open forested areas

and were difficult to find within Krka NP boundaries. Including this habitat would involve the creation of more transects and is something that can be considered for the following years. Especially if a second camp is opened and/or the number of staff increases.

## 2. Biodiversity surveys

### Birds

#### *Constant effort sites (CES)*

There are seven Sites at the moment of writing. Every site consist of 8 x 12m nets. Two CES in Juniper dominated habitat (Site 1 – not in KRKA NP boundaries, 3) and two sites in riverine forests (Site 5, 7 – little productive?), attempts were made for sites in oak dominated forest (Site 2, 6) but both were unproductive (4 birds max). A third category was initiated along the reed beds (*Phragmites*) at the lake close to the house. This last site is valuable to look into warblers and water associated species.

For 2019. A second reed bed site would be valuable, and is an optional addition. Oak dominated sites seem not to give that many different species and tweaking would be needed. Net positions should be fixed and attached to (large) stones/trees and marked with spray paint. GPS coordinates for both poles are used.

#### *Point counts*

Point counts are supposed to be completed at the dawn chorus to standardize surveys both in time (during and over survey seasons on the site) and between OPWALL sites. Diversity is relatively low (few species). In 2019 there is a tendency for the start point of point surveys to drift to a later hour. At the moment of leaving, no reverse transects were completed yet.

### Butterflies

Pollard walks and point counts. Intensive surveys (8-10 surveys a week). All butterflies considered, where possible butterflies were caught and photographed. Point counts are included for dissertation projects and engagement of students.

Data analysis of transect data (for dissertation) will be broken up in smaller parts (50-300m) based on habitat classification.

Species composition changes during the season and it is important to equally sample the transects. Species have different activity peaks during the day (reflected in morning and afternoon surveys, eg more Lycaenidae). The survey protocol is updated to incorporate this variation.

#### Possible publications:

- Updated species list (several species new to Krka NP)
- Community structure
- Pop density of *Iphioides podalirius* (common, but few on transects).

### Amphibians and reptiles

- Transect based visual encounter surveys and two tortoise polygons representing a dense forest and an open meadow (capture-recapture) for the dissertation. A minimum of three repeats aimed for during the season, probably should get up to five. Substantial time invested in searching for the tortoises in the polygons takes away time from transect surveys.

## Habitat structure

Protocol conceived (and 2020 aspired) based on Honduras habitat structure assessments (20m-20m plot), but adjusted for use in more dry and open areas. Added biomass (3m wide), measure the circumference of all woody plants and estimate height for all in the central cross in the plot. Light measurements are added to plot assessments.

Adjusted the habitat surveys for 2019 to have a smaller surface (10m-10m) that fits in the larger plot (20m – 20m) to be used from 2020 onwards. Density (touch poles) and biomass (woody plants) is used on two of the outer edges. For 2020, plots need to be expanded again to the 20-20m size.

At the moment of leaving no GIS based habitat categorization is available yet. Grace will use the plot data to generate a rough preliminary classification of habitat types (considering burned Juniper, Juniper, oak forest and hornbeam forest) that will be used by both dissertation students for their projects.

## Bats

Bat surveys are not in the core monitoring in 2019. Idea was to run all transects with acoustics and evaluate the possibility to include this in the core monitoring for next year. Additional suggestion is to use the Krka River as a dispersal corridor and feeding ground for bats (especially with all the caves in the canyon) and to identify several locations along the river for both mist netting and acoustics. A combination of both survey methods on the same sites would be good.

At the moment of leaving as good as no data is available. Bat surveys were performed highly irregular and on gut feeling on the flying conditions. Site selection is unstructured and data collection for the random sites is incomplete. No confirmed constant effort sites for bats are available at the moment of leaving. A senior bat scientists for 2020 is needed.

## Mammals

*Tracks, signs and dung.* The mammal team will run all transects twice in the season. Once at the beginning of the season and once at the end to survey transects for signs and tracks of large mammals.

*Camera traps* were used opportunistically in 2019 to confirm the presence of several large mammal species in the new region. Confirmations of wild boar, roe deer, red fox, beech marten, badger and wild cat are available at the moment of leaving.

Suggestion for 2020, set up a fixed grid of 1km squares (points need to be independent from each other) aiming at carnivores. The idea is to have a grid for monitoring the influx of wolves and jackal and monitor populations of red fox, beech marten, wild cat and badger. There are however many different models with slow trigger speed (0.3 – 1 sec.). There is a need for better camera traps with a faster trigger speed (0.2 sec.) for standardized data collection.

*Sand patches* – Were tried in a standardized way (0.75m-0.75m) at survey sites with white Rhine sand. Sand loses cohesion and holds tracks poorly. Not recommended for this site (warm, dry) as it will not generate valuable data.

*Small mammal live trapping* – Local traps were placed in trap lines of ten (5m apart), with a mix of peanut butter and oatmeal for 3 days. Not a single animal was caught, cages were sometimes closed, often open without bait. Local traps use a hook trigger mechanism that is not as reliable as a pressure plate.

For 2020 it might not be worth continuing the small mammal live bait trapping. In an initial second phase definitely not in the core monitoring. If this survey is to be continued at least Sherman traps are needed (enough for two trap lines of 10 with some spares – eg 23). Potentially some smaller Sherman traps to look at smaller species (shrews), also Sherman.

## Caves

Cave surveys (specialist research project) are ad hoc and aim to collect any species searching for rare records and new species to science. There is potential for standardized surveys looking at productivity, biomass and quantification of cave systems. Working with stable isotopes would be interesting.

### *Archeological finds*

The new site allowed also to investigate some new caves and some archeological relevant finds were made (including old pottery, tissue and a jaw of human (robust!) – potentially Neanderthal?). Recording, processing and curating of these valuable finds happen in a not so professional way potentially decreasing the value of the findings and objects.

## Fish

This project aims at removing invasive fish (specialist research project). Suggestions are made to standardize the surveys and work with trapping locations selected to cover the different habitat types on the lake edge with enough replication in the relevant habitats so that it can be used and repeated next year. Since the lake was probably drained 6 years ago, very little (invasive and also native) fish is present, but this is a good baseline survey to follow up (re)colonization of the lake over the years. As a reference for an undisturbed natural situation, the waterways below the dam are sampled.

For 2020 a repeat of the same sampling sites would be good. For the moment only sampling in the upper waterways is performed and nets with large maize sizes. It would be good to think about trapping ways to quantify the native fish populations.

## Light trap

Light trap (125W Mercury vapour bulb) was tried for several nights close to the house (limited by the length of the electrical wire). Only few hawk moths were observed (5 in total, 2 species), no emperor moths, but an overall good diversity of other moths (about 100 species) were photographed for identification later. A good diversity of beetles was present. The light trap seems like a valuable nocturnal survey to be added to the program. It would be particularly interesting to have a small generator and to do standardized light trap surveys on transects.

### 3. Dissertation projects

Kristie Falconer: Main hypothesis is to look at how butterfly communities differ between habitat types (Pollard walk section in different transects with a min of three repeats) and whether flight height differs between butterflies (genus level) and can be explained by (habitat, animal size or host plant height). On track for data collection and statistics (in R).

Eve : Main hypothesis is looking at the population size of Hermann`s tortoise, habitat use and look into dispersal of tortoises (powder). Data collection started slow, at the moment of leaving two habitat polygons (open meadow and forest) are identified and regularly randomly (but quantified by distance and survey time) searched for tortoises. Seven animals are found. Continuous search effort should give enough results. Statistical analyses were only briefly touched upon.

Leo Hvr: Survey on fungi in caves. No clear research hypothesis and data collection method. Suggestions were made for a defined research question and quantifiable data recording/standardization of data. No attempts were made beyond this.

#### 4. Data centralization and information placed online

Teams are asked to process all their data in the provided and shared G-drive(s). The idea is to have an online back-up of all the data and feel of real life data collection. Data will be backed up at the external BIOTA hard drive at the end of the season.

Information on GIS data (transects, CES), last versions of the sampling sheets and data Excel files is provided in the G drive.

Crib sheets were assembled for all teams in Croatia complementary to the survey protocol. The focus is on providing an overview of all required steps for a field survey with students from leaving the OPWALL/BIOTA house (signing out) to the return (signing in). The crucial part is focusing on the equipment needed during the surveys and also on the different topics that need to be covered during the explanation from the scientists to the students.

#### 5. Climate data recording

Essential for next year is to have a weather station available in the house. A solar powered wireless weather station that record a wide range of variables (eg Davis Vantage Vue – 300USD) including precipitation would be a good choice. Alternatively at least a single data recorder (temperature and humidity) should be placed, ideally some more (recording variables on each of the six transects) in the different habitats (eg differences in the canyon close to the water, versus forest temperatures and open grassland on the plateau).

#### 6. Conclusion

A baseline is created with a careful but firm push for more transect based surveys for selected groups positively embraced by most teams on site. Replications next year should be re-evaluated and upped where possible (mostly for herps). Methodologies are tested and survey sites evaluated for bats and mammals (opportunistic biodiversity surveys) and pending on end of the season results these surveys could be considered for insertion in the core monitoring program.

Staffing of (senior) survey positions is crucial in Croatia compared to the larger projects. Biodiversity monitoring teams need a minimum of two staff to decrease fluctuations in data collection quality and efficiently with a carefully selected senior team member (ideally with OPWALL experience from another site).

#### 7. Appendix 1. Transects

**Transect 1 (2600m): *Juniper grassland/ Quercus bush*** Start is close to the house. Go through the garden at the back of the house, over the grand canyon to the concrete block, this is the beginning of transect. The transect ends at the road to the small village, return over the dirt road and then over the main road.

Survey Sites (7): 250m, 600m, 950m, 1350m, 1900m, 2300m, 2600m

Start point: 43.98832 16.04937 (T1 0m)

End point: 43.994172 16.060951 (T1 2600m)

**Transect 2 (350m): *Juniper grassland on slope*** This short transect is best combined with transect 3. It is easiest reached through the main road (left when leaving the house), take the first asphalted road to the left, traverse the small village to the large white house at the end of the road. Here a track starts that passes two barking dogs and the nice people in the white house on the left (please wave and say “Dobar dan”). Follow the trail all the way to the beginning of transect2. Crossroads are marked to indicate the right track. Return by back tracking.

Survey sites (2): 0m, 250m  
Start point: 44.00583 16.05732 (T2 000m)  
End point: 44.00671 16.05561 (T2 350m)

**Transect 3 (900m): Riverine forest and some patches of grassland** Start of transect is at the end of transect 2 (see description there). A small track goes in the forest to the left, this track is followed to the end. Return through back tracking.

Survey sites (4): 100m, 400m, 600m, 900m  
Start point: 44.00676 16.05548 (T3 000m)  
End point: 44.01041 16.0602 (T3 900m)

**Transect 4 (1000m): Rocky slopes and forest** Start of transect is in the beginning of the track marked on the side of the road. Get there by taking the road through the village. Return by backtracking outside of the forest and taking the rocky track to the left uphill to loop back to the road.

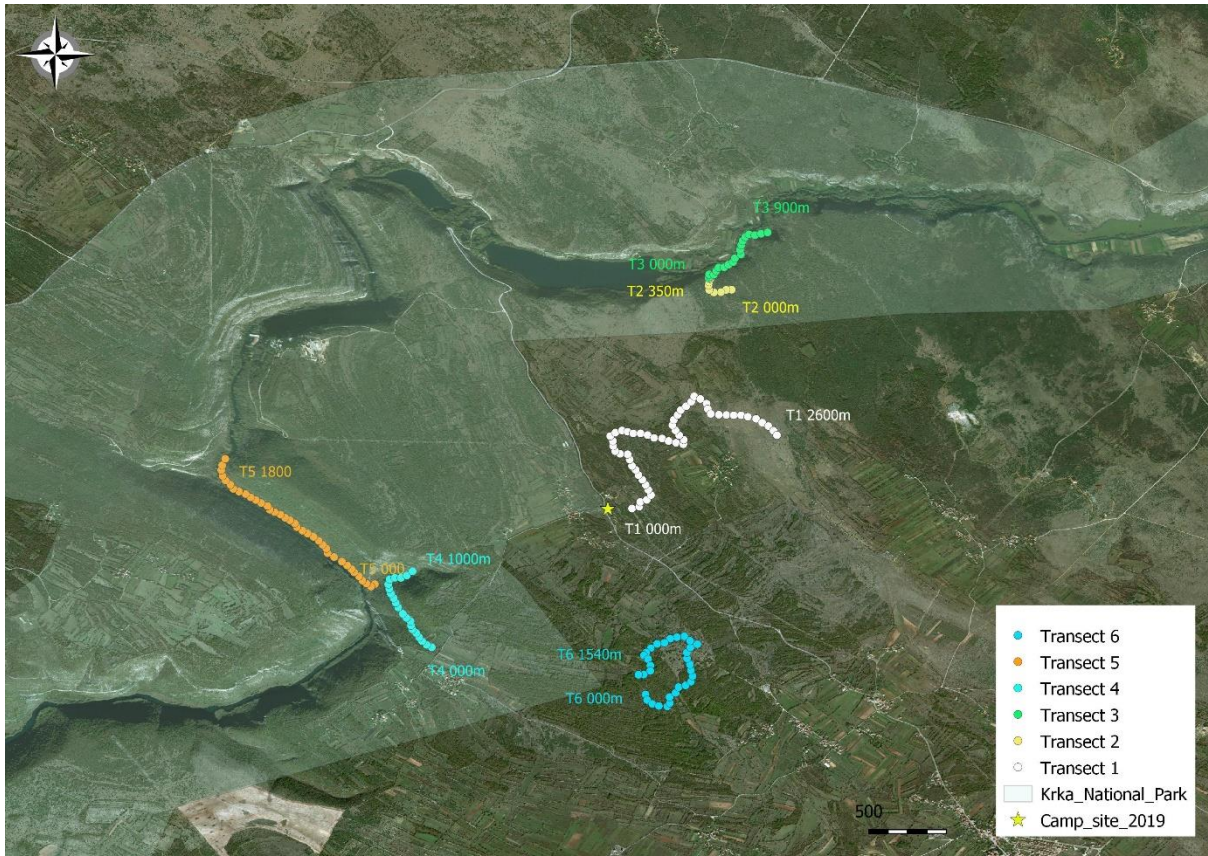
Survey sites (3): 350m, 600m, 1000m  
Start point: 43.97719 16.03329 (T4 000m)  
End point: 43.98328 16.03175 (T4 1000m)

**Transect 5 (1800m): Riverine forest** To get to the start of transect 5, begin by transect 4, and at the mid 700m mark of transect 4, take a left to the bottom of the gorge. Transect 5 starts in the beginning of the first flat ground on the trail. Return by backtracking or through looping back over the shortcut. After the last mark on transect, follow the trail that starts along the river and gently zigzags uphill in the forest to an open track that ends on the road. Here leave the road immediately to the right and climb up the marked track. Follow this until you reach the village.

Survey sites (5): 0m, 350m, 650m, 1200m, 1750m  
Start point: 43.98225 16.02873 (T5 000m)  
End point: 43.99228 16.01674 (T5 1800m)

**Transect 6 (1540m): Quercus forest and Juniper grassland** Walk from the house in the direction of transect 4. After the monument for the partisans on the left, take the first dirt track to the left. Follow this track until it curves to the right and a marker indicates where to get off the track to go through a nice stand of oak forest and reach a well maintained dirt track. Take here to the left and at the next crossing to the right to reach a little stone house in the forest. Transect starts in front of the house in the oak forest and returns on the dirt track after 1545m, take a left on this track to go back to the stone house with the inviting seats outside, to the right takes you back to the OPWALL house.

Survey sites (5): 0m, 450m, 850m, 1050m, 1400m  
Start point: 43.973416 16.050413 (T6 000m)  
End point: 43.974991 16.049849 (T6 1545m)



**Figure 1.** Transects for the OPWALL site, Krka NP, Croatia 2019.