Mountain Bike Trails in Jurapark Aargau (CH) – A Density Use Analysis with ArcGIS Pro

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1. Motivation and Goal

The demand for recreational space in nature is growing [1]. At the same time, the needs of those seeking recreation are becoming more diverse with mountain biking standing out as an increasingly practiced sport in Switzerland. Especially in the forest, conflicts with hikers or foresters are becoming more common, often due to mountain bikers riding on illegal trails [2]. To minimize such conflicts, the Jurapark Aargau developed a recreation concept which intends to guide visitors in the best possible way so that their needs are met while ensuring the protection of nature and the landscape [3].

The focus of this bachelor thesis is to determine the density of use of mountain bike trails in the entire area of Jurapark Aargau. The resulting maps serve as a basis for assessing in which areas priority should be given in handling illegal mountain bike trails.

2. Methods Overview and Results

2.1 Questionnaire with ESRI tool Survey123

A questionnaire with the Esri tool ArcGIS Survey123 was first created for mountain bikers in Jurapark Aargau to identify popular bike routes and portals. The most important findings were that about ¾ of the participants use portals for their tour planning and that the most popular portals in this area are Komoot, Strava and Outdooractive (see figure 1).

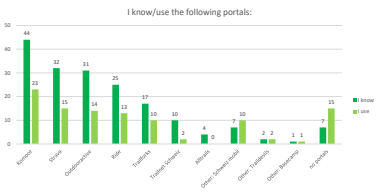

Figure 1: Results of the most important findings of the questionnaire filled out by 54 participants

2.2 Data preparation

Based on the questionnaire and in consultation with Jurapark Aargau, suitable portals were selected for the density use analysis, based on two criteria:

1) the number of trails in Jurapark Aargau area
2) the possibility to download the trails

After an examination of eight popular portals, three portals (Alltrails, Outdooractive, Trailforks) were used to download 277 mountain bike trails for the usage density analysis within ArcGIS (see figure 2).

2.3 Density Use Analysis

The downloaded trails were reviewed and integrated into ArcGIS Pro. Different tools and self-developed methods were tested to find dense spots of mountain bike trails in Jurapark Aargau.

An unweighted analysis was performed with the assumption that the density of use correlates with the number of published routes per area.

Figure 2: Map of mountain bike trails in Jurapark Aargau downloaded from three portals (in green)

The following tools were evaluated: “Kernel Density”, “Line Density” (see figure 3) and “Heat Map”.

Further, two methods were conducted with the help of Esri ModelBuilder to show how many trails exist within a cell of one hectare, and the length of all trails within a cell of one hectare:

Method 1: The tool “Cell Statistics” to identify the number of trails within a cell was used on the rasterized trails (see figure 4).

Method 2: The tools “Create Fishnet” and “Pairwise Intersect” were applied.

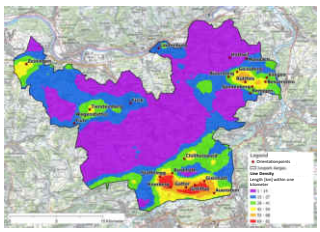

Figure 3: Usage density visualized with the ArcGIS Pro tool «Line Density»

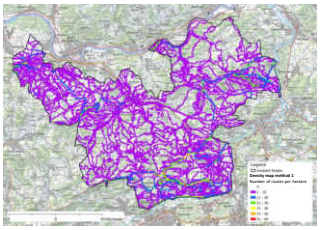

Figure 4: Usage density visualized with the Method 1 showing how many trails lead through one hectare

With the help of the maps the hotspots could be identified. The three largest hotspots are located 1) at Jura Südfuss (Homberg and Gisliflue elevations), 2) at Geissberg, and 3) at Tiersteinberg. Regarding the landscape, the dense sites are located on higher elevations in the forest or at the edge of the forest. Due to the different approaches, as well as the different tools and methods, the representation and size of the hotspots in the density maps differ.

2.4 Walk-through and verification

As a result of a walk-through and verification of the densest spots on site, the conflict potential of individual sites was assessed. Especially at crossings (see figure 5, 6 and 7) and on narrow paths the danger of conflicts and accidents was rated high.

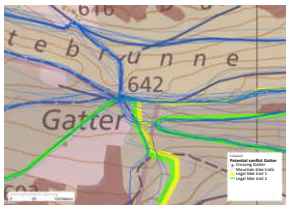

Figure 5: Overview of downloaded mountain bike trails (in blue) and legal trails (in green and yellow) on a crossing in Jurapark Aargau

Figure 6: Illegal path for bikers on the crossing

Figure 7: Information board for bikers at the crossing

3. Conclusion

Within this thesis it could be shown that **it is possible to develop a density of use map of mountain bike trails based on popular bike portals and to identify high usage densities, so-called hotspots, using ArcGIS Pro.** The determination of the density of use is an important basis to design measures against illegal mountain bike trails in Jurapark Aargau.

This bachelor thesis was supervised by Monika Niederhuber (ETH Zurich, Department of Environmental Systems Sciences) and Lea Reusser (formerly Jurapark Aargau).

References
[1] Reusser, L. (2021a). Erholungsplanung Jurapark Aargau. https://jurapark-aargau.ch/erholungsplanung
[2] Ruoff, A. (2020). “Die meisten Knackpunkte gibts im Wald.” Jurapark-Zytig, 36, 1–24.
[3] Reusser, L. (2021b). Zoom meeting in the context of the bachelor thesis [22.10.2021].

Data sources
Swiss Map Raster 100 1:100,000: © swisstopo; Perimeter: © Jurapark Aargau; Bike trails: Alltrails, Outdooractive, Trailforks