TrailSeeker: Utah MTB Planning System

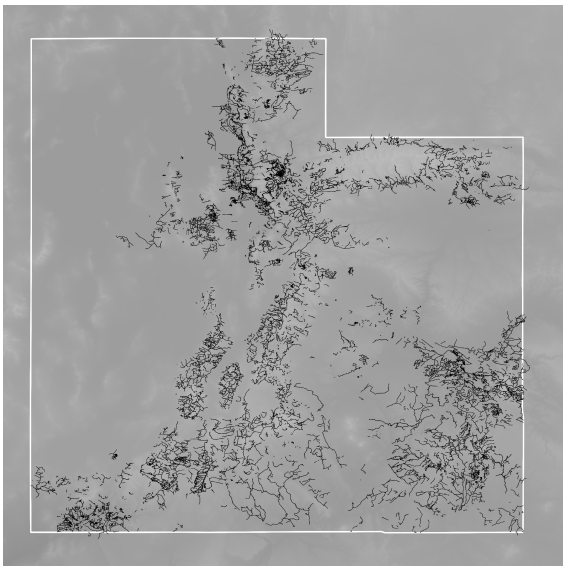
Joe Tayabji

GEOG 6150 12/15/2023

Introduction

Physical trail maps have historically been a way for outdoor recreationists to access nature, while balancing preservation and safety (Senda-Cook, 2013). They allow users of all types to understand where they can safely go and where they should not. Modern websites and smartphone apps such as Trailforks[1] and MTB Project[2] use geolocation features to expand on the traditional trail map. Both apps have over 100,000 miles of trails and allow users to see maps and find their location via GNSS.

Mountain bike tourism has increased in the past decade, and the average mountain bike tourist spends $400 per trip (Buning, Cole, & Lamont, 2019; Moularde & Weaver, 2018). One area that is known to most avid mountain bikers world wide is Moab, Utah. More broadly, the state of Utah is considered to be a mountain bike mecca by many (Figure 1).



[1] https://www.trailforks.com/
[2] https://www.mtbproject.com/

Figure 1: Mountain biking trails in Utah

The United States Forest Service (USFS) has maintained an outdoor recreation database well before modern computing (Rosenberg & Loomis, 2000). Visitor forecasting and national benefit forecasting is regularly done, and biking is one of the categories monitored. Utah is a state where land managers such as the USFS and Bureau of Land Management (BLM) have a comparatively large management presence when compared to other states, as many of the areas are considered to be highly traveled (Zhang & Smith, 2023).

The previously mentioned apps work great for discovering trails, and work especially well for finding a real time location. They can also show features such as parking and viewpoints. However, there is room for additional functionality, especially in the context of trip planning. Information regarding bike shops, campgrounds, shower facilities, and emergency medical services are crucial, among other considerations. TrailSeeker is a project designed to weave several features together to create a comprehensive database that can be used to plan a mountain bike trip in Utah.

Methods

The first step in designing the database was using an ER diagram (Figure 2) to serve as a baseline for the first relations, and then sourcing them. Shapefiles representing well known features of importance were gathered. The first of these, of course, were trails. A shapefile of these were downloaded from the Utah Geospatial Resource Center[3] (UGRC), as well as shapefiles representing ski areas, trailheads, emergency medical services, landmarks, and features. State, county, and city data was sourced from the USDA:NRCS Geospatial Data

[3] https://gis.utah.gov/data/

Gateway[4]. After creating this baseline, information about bike shops and shower facilities was sourced using Google Maps. This information was stored in a .csv file and included latitude and longitude coordinates.

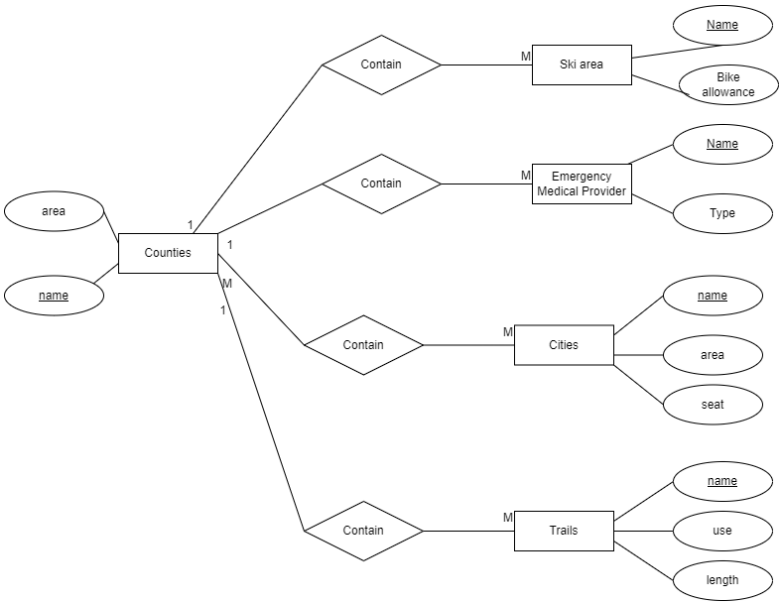


Figure 2: ER Diagram

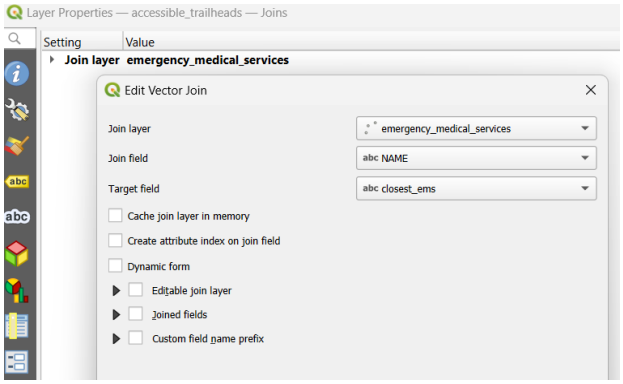
The shapefiles were opened using QGIS and were determined to appear accurate and complete. A connection was made between QGIS and postgreSQL/PostGIS, accessed using pgAdmin. This data was added to a schema and their spatial references were transformed to NAD83 UTM 12N. These features also required spatial indexes so they could be queried more efficiently. Tables were created to hold the .csv files and they were added with geometries. In QGIS, relevant spatial queries were performed to create new tables. A table was created to hold trails where biking is allowed, and another was created for biking-only trails. Trailheads were filtered to separate those within 1.5 km of a trail. The location of the closest emergency medical service provider was appended to this filtered table of accessible trailheads. These updated tables were brought back to QGIS for inspection.

[4] https://datagateway.nrcs.usda.gov/

```sql
-- the cities table was imported from qgis
SELECT * FROM utah_mtb.cities;
-- composite key needed to account for cities (i.e. Park City) in multiple counties
ALTER TABLE utah_mtb.cities
    ADD PRIMARY KEY (countynbr, name);

-- this table is in WGS 84 (4326)
-- transform to NAD83 UTM 12N (26912)
ALTER TABLE utah_mtb.cities
    ALTER COLUMN geom TYPE geometry(MultiPolygon, 26912)
    USING ST_Transform(geom, 26912);

SELECT st_srid(geom) as spref
    FROM utah_mtb.cities;
```



accessible_trailheads — Features Total: 531, Filtered: 531, Selected: 0

	id	objectid	primarynam	trailheadi	closest_ems	emergency_medical_services_OBJECTID	_medical_services_	y_medical_services	ncy_medical_servic	icy_medical_servic	ncy_medical_servi	y_medical_services	ncy_r
1	1	1	Deer Creek Parkway No...	OV21654	WASATCH COUNTY EMERGENCY MEDICAL SERVICES	40	435-654-9728	100 WEST 100 ...	HEBER CITY	UT	84032	WASATCH	4905
2	2	2	Sleepy Hollow	OV55779	WASATCH COUNTY EMERGENCY MEDICAL SERVICES	40	435-654-9728	100 WEST 100 ...	HEBER CITY	UT	84032	WASATCH	4905
3	3	3	Osborne	OV84736	UNIFIED FIRE AUTHORITY STATION 114	12	801-743-7100	14324 S FIREH...	DRAPER	UT	84020	SALT LAKE	4903
4	4	4	Dead Dog Loop	OV182462	CARBON COUNTY AMBULANCE	162	435-636-3267	1560 AIRPORT ...	PRICE	UT	84501	CARBON	4900
5	5	5	Upper Setting	OV210972	SOUTH SUMMIT AMBULANCE	189	435-783-6276	220 E 400 S, KA...	KAMAS	UT	84036	SUMMIT	4904
6	6	6	Dry Canyon (Logan)	OV256796	LOGAN FIRE AND EMS STATION 71	119	435-716-9500	1244 E 1100 N, ...	LOGAN	UT	84341	CACHE	4900
7	7	7	Bench Creek	OV285197	WASATCH COUNTY EMERGENCY MEDICAL SERVICES	40	435-654-9728	100 WEST 100 ...	HEBER CITY	UT	84032	WASATCH	4905
8	9	9	Little South Fork of Provo	OV364324	SOUTH SUMMIT AMBULANCE	189	435-783-6276	220 E 400 S, KA...	KAMAS	UT	84036	SUMMIT	4904
9	10	10	Three Amigos	OV467027	VERNAL FIRE DEPARTMENT	195	435-789-4222	495 E MAIN ST,...	VERNAL	UT	84078	UINTAH	4904
10	11	11	McCoy Flats	OV483021	GOLD CROSS AMBULANCE - EASTERN UTAH DIVISI...	194	435-789-6907	220 WEST 100 ...	VERNAL	UT	84078	UINTAH	4904
11	12	12	Terrace Hills	OV545736	SALT LAKE CITY FIRE DEPARTMENT STATION 4	86	801-596-5244	830 E 11TH AVE...	SALT LAKE CITY	UT	84103	SALT LAKE	4903
12	13	13	Bella Vista Court	OV610436	FARMINGTON FIRE DEPARTMENT	105	801-451-2842	82 N 100 E, FAR...	FARMINGTON	UT	84025	DAVIS	4901
13	15	15	Antelope Island (Bridge...	OV645208	SYRACUSE FIRE DEPARTMENT	261	801-825-4400	1751 S 2000 W...	SYRACUSE	UT	84075	DAVIS	4901
14	16	16	Right Hand Fork (Mud ...	OV688921	NORTH LOGAN FIRE AND EMS	26	435-755-5739	2005 N 1200 E, ...	N LOGAN	UT	84341	CACHE	4900
15	17	17	5 Miles of Hell	OV715524	HANKSVILLE FIRE DEPARTMENT	152	435-542-3285	45 WEST MAIN ...	HANKSVILLE	UT	84734	WAYNE	4905
16	18	18	Solitude Resort	OV730627	UNIFIED FIRE AUTHORITY STATION 108	226	801-743-7100	12601 E BIG CO...	BRIGHTON	UT	84121	SALT LAKE	4903
17	19	19	Yellow Fork	OV750683	UNIFIED FIRE AUTHORITY STATION 123	231	801-743-7200	4850 W MOUN...	HERRIMAN	UT	84096	SALT LAKE	4903
18	20	20	White Pine	OV760344	UNIFIED FIRE AUTHORITY STATION 113	151	801-278-9987	9523 E BYPASS ...	SANDY	UT	84092	SALT LAKE	4903
19	22	22	Mill D South Fork	OV793335	UNIFIED FIRE AUTHORITY STATION 113	151	801-278-9987	9523 E BYPASS ...	SANDY	UT	84092	SALT LAKE	4903
20	23	23	600 S (JRP)	OV801001	SALT LAKE CITY FIRE DEPARTMENT STATION 6	16	801-596-5246	948 WEST 800 ...	SALT LAKE CITY	UT	84104	SALT LAKE	4903
21	24	24	Mill Creek Lower	OV802597	PARK CITY FIRE DISTRICT STATION 36	245	435-940-2500	197 W CANYO...	PARK CITY	UT	84060	SUMMIT	4904

Figure 3: Software screenshots

Results

The start of a promising database allowing for mountain bike trip planning was created. The addition of emergency medical services was a valuable safety feature, and considerations like this will be necessary as the database is expanded. The Western Rim, East Forks Black Fork, and Piute Pass trailheads were found to be the bike trailheads that were furthest from a Utah emergency medical service provider (Figure 4).

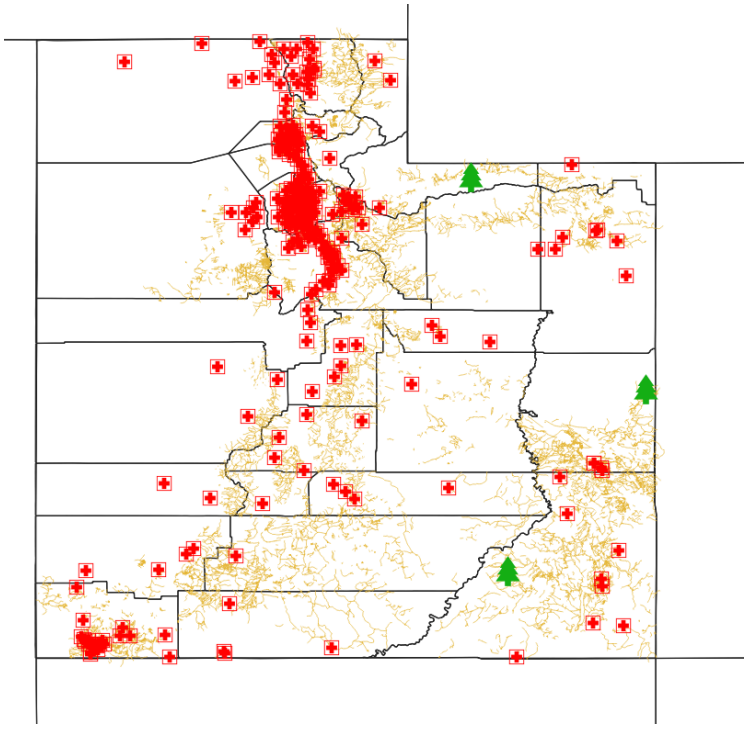


Figure 4: The three trailheads farthest from a Utah EMS provider are shown

Discussion

A more comprehensive database is useful in the context of all outdoor recreation. It allows for planning all aspects of a trip, including both the anticipated enjoyment and an unanticipated emergency. Additionally, land managers can use a system like this to optimize the location of new trails. Furthermore, this demonstrates the power of using both QGIS and PostGIS together, as they allow for fairly quick processing and visualization.

Ongoing work will be required for TrailSeeker, including data scraping and using APIs to gather much more information efficiently. Moreover, this approach is suitable for a wider geographic area than Utah. The other states of the Four Corners would be great additions. Finally, interactive web mapping would be a necessary step. This approach will only be valuable if it can be made usable for others in the community.

References

Buning, R. J., Cole, Z., & Lamont, M. (2019). A case study of the US mountain bike tourism market. Journal of Vacation Marketing, 25(4), 515-527.

Moularde, J., & Weaver, A. (2018). Serious about leisure, serious about destinations: mountain bikers and destination attractiveness. In Sport Tourism and Sustainable Destinations (pp. 123-141). Routledge.

Rosenberger, R. S., & Loomis, J. B. (2000). Using meta‐analysis for benefit transfer: In‐sample convergent validity tests of an outdoor recreation database. Water Resources Research, 36(4), 1097-1107.

Senda-Cook, S. (2013). Materializing tensions: How maps and trails mediate nature. Environmental Communication: A Journal of Nature and Culture, 7(3), 355-371.

Zhang, H., & Smith, J. W. (2023). A data-driven and generalizable model for classifying outdoor recreation opportunities at multiple spatial extents. Landscape and Urban Planning, 240, 104876.