Internship Brief
Geomatics for the Built Environment

Squirrels in the neighbourhood:
quantifying the potential for biodiversity surrounding a building site

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February 2023

TU Delft

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This brief is a public version of the confidential written record of an internship carried out in the period September 20, 2022 - February 23 2023. The internship is an elective of the MSc Geomatics for the Built Environment, Delft University of Technology, awarded with 10 ECTS.

Abstract

Urban wildlife plays an invaluable role in cities, including the promotion of overall biodiversity and greenery, pollination and human connection to nature. This internship project involved the development of a prototype that quantifies the potential for local ambassador species to visit a building site based on the amount and connectivity of habitat in the neighbourhood. The workflow integrates vector layers from open datasets and Arup ecologists' expertise on animal behaviour in order to quantify the cost of moving through an urban environment. Initial results show that the prototype enables the numerical and visual comparison of connectivity for 7 out of the 10 ambassador species, with the Bee demonstrating the highest connectivity, and Toad having the lowest connectivity. This prototype has the potential to support Arup's work on facilitating more connected urban environments for local wildlife, all the while improving urban ecology overall.

Introduction

About Arup

Arup is a collective of 17,000 designers, advisors and experts working across 140 countries on a variety of sustainable development projects, including design, architecture, engineering, urban planning and digital solutions. The applications of Arup's work range widely, from creating transportation plans to designing signature buildings and infrastructure, to developing digital tools for managing the built environment. The Netherlands group is composed of three business units: Sustainable Property, Sustainable Industries and Sustainable Cities & Transport, and team members have local expertise while also collaborating on global projects.

About the Digital Team

The company portfolio varies across office locations, but this specific internship was designed to integrate with the Geospatial team in Ireland and the Digital team in Amsterdam. Both teams offer specialized technical skills to various units across the company in order to support a variety of (geo)data management, analysis, modelling, programming and other digital needs and challenges posed by different projects. The Digital Team, which is housed in the Sustainable Property unit, is composed of front-end and back-end developers and analysts, many of whom have previous experience in structural engineering, architecture, business and other relevant fields. In addition to providing project support, the Digital team develops innovative tools that enable clients to work towards sustainable development goals and supports consultants with their work, such as resilience planning, seismic risk analysis, parametric design, net zero carbon emissions and much more.

Project objective

The aim of this project was to develop a prototype that would support the assessment of a building site's potential for biodiversity by considering the land cover surrounding the site and the needs of various ambassador species.

Research Methodology

Data

The first step in the research was to source the datasets to represent the location and features of various land cover and land use in the study area. Informed by the project team and the work of ecologists at Arup, the initial search focused on roads, noise, water, vegetated areas and wind, which were deemed to be important in influencing the movement of animal species. Some time was spent with exploratory research to identify additional datasets that may be relevant to biodiversity mapping. Given the large amount of openly available data in the Netherlands, the challenge in this step was deciding on which datasets were most appropriate to use. Efforts were made to keep the number of datasets at a minimum by focusing on a few large national datasets that contain many features. This choice was made for two reasons: first, to make the project as replicable as possible, and second, to maximize the cohesiveness of the data by using a dataset that was generated using a single methodology (e.g. minimizing overlaps between terrain types).

Figure 1. Initial findings in the exploratory data survey

By the end of the internship project, 25 layers of data in vector format were sourced and processed from seven different datasets, as shown in figure 1. All these datasets are openly accessible from national, provincial or municipal organizations. The majority of datasets were downloaded directly from the websites, with a few being available via WFS or APIs. Once these datasets were obtained, ecologists from different offices of Arup were asked to quantify the cost of crossing each of the land cover types, and identify habitats and barriers.

Tools

QGIS is an open source software for geographic information science. It was used to visualize initial datasets and analysis outputs, as well as carry out small data processing tasks (e.g. clips, attribute updates, merging layers) at the beginning of the project. The majority of the project involved developing scripts using the python programming language with Visual Studio Code as the Integrated Development Environment. The python libraries used include:

- Rasterio: a Python API based on Numpy N-dimensional arrays and GeoJSON used to read, process and write raster files, based on the Geospatial Data Abstraction Library (GDAL) data model.
- Geopandas: an open source library for working with geospatial vector data. This library extends the datatypes used by pandas, and makes use of shapely for geospatial operations and fiona for reading and writing files.
- Scikit-image: an open source library for image processing.

Results

The outcome of the internship is an independent Python script that can quantify the connectivity of a building site for ambassador species based on layers of multiple input vector datasets and a building site location. The surroundings analysis was run for nine species: The highest Connectivity Index (CI) was that of the Bee at 25.38 as shown in figure 17, and the lowest CI was that of the toad at 0.08, as shown in figure 18.

Conclusions and Next Steps

Animals move through the urban environment in complex ways. This prototype aims to measure and express such complexity by quantifying the potential for local ambassador species to visit a building site. The workflow integrates vector layers from open datasets and Arup ecologists' expertise on animal behaviour in order to quantify the cost of moving through an urban environment. Initial results show that the prototype enables the numerical and visual comparison of connectivity for 7 out of the 10 ambassador species, with the Bee and Sparrow demonstrating the highest connectivity, and Toad having the lowest connectivity. Urban wildlife plays an invaluable and often overlooked role in cities, including the promotion of overall biodiversity and greenery, pollination, human connection to nature, and other ecosystem services. This prototype has the potential to support Arup's current and future work on facilitating more connected urban environments for local wildlife, all the while improving urban ecology overall.

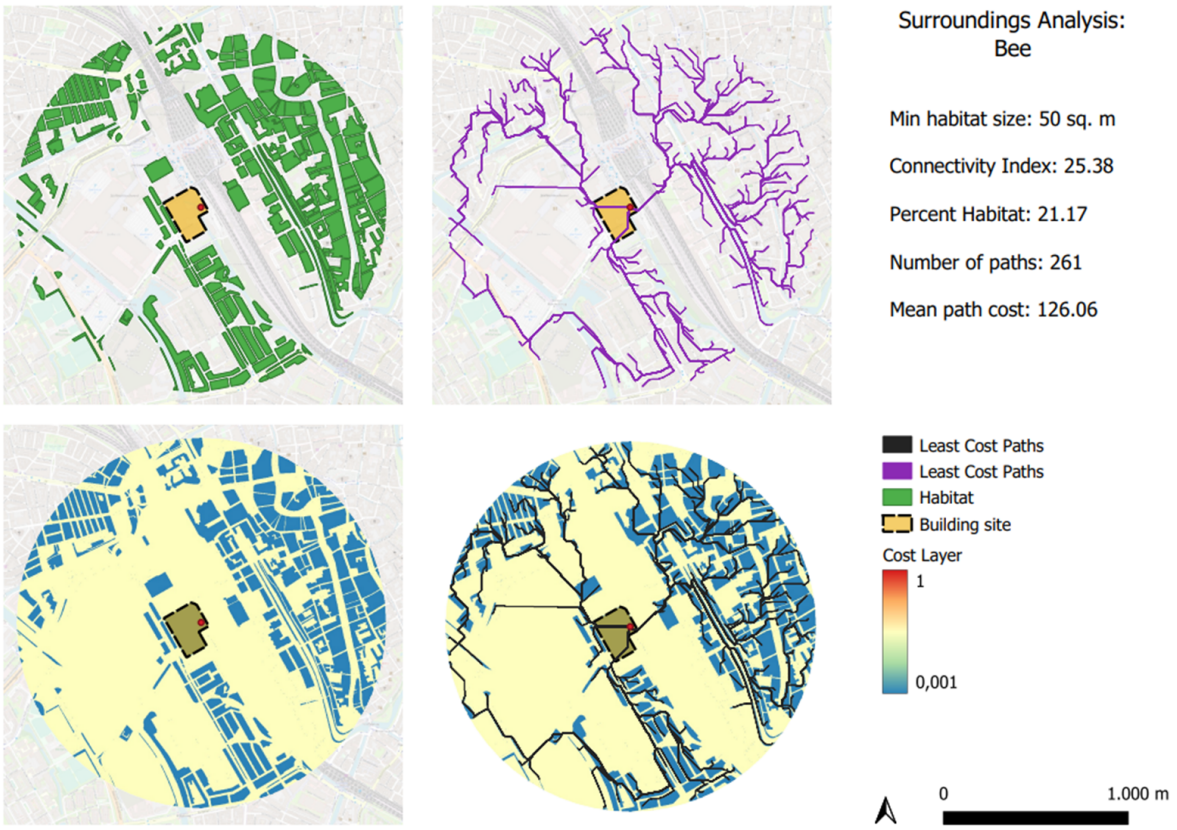

Figure 2. Surroundings analysis result for the Bee (highest CI)

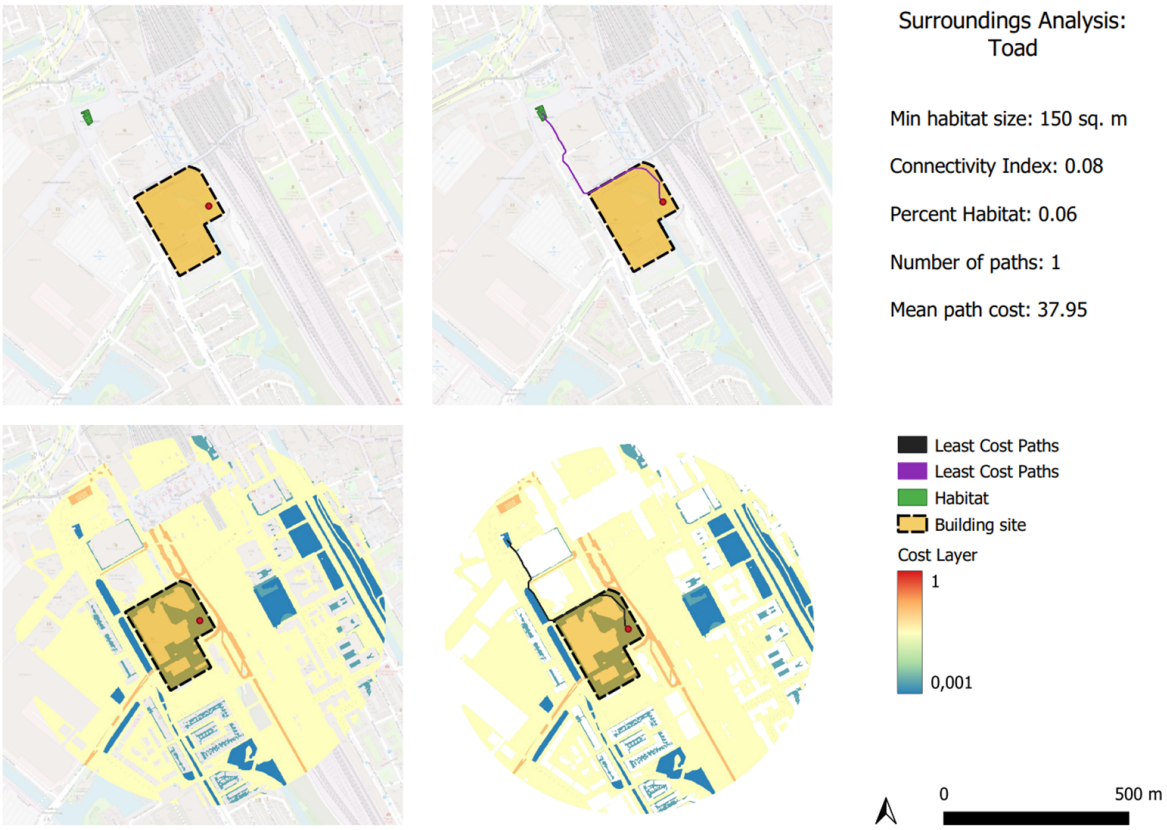

Figure 3. Surroundings analysis result for the Toad (lowest CI)